CNR 89 / May 1984

AN EVALUATION OF USING JOB PERFORMANCE TESTS TO VALIDATE ASVAB QUALIFICATION STANDARDS

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CENTER FOR NAVAL ANALYSES

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1. The objective of the job performance study is to determine the feasibility of validating enlistment standards and assignment criteria against eventual job performance. The portion of the study covered by this report has been designated as Phase I and was intended to determine the feasibility of validating enlistment standards and assignment criteria against eventual job performance using three MOS's which represent a spectrum of Marine Corps skill requirements.

2. The Phase I objectives were met.

3. Phase I determined that the validation was feasible. Work has begun on Phase II, a long-term validation for other MOS's.

4. A copy of this letter will be affixed inside the front cover of each copy of the study report prior to its distribution.

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AN EVALUATION OF USING JOB PERFORMANCE TESTS TO VALIDATE ASVAB QUALIFICATION STANDARDS

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ABSTRACT

The purpose of this study was to evaluate the feasibility of validating ASVAB enlistment standards against job performance. Hands-on and written proficiency tests were developed for three Marine Corps skills--Ground Radio Repair, Automotive Mechanic, and Infantry Rifleman--for use as measures of job performance. In addition, grades in skill training courses were also evaluated as possible measures of job performance.

The ASVAB was shown to be a valid predictor of job performance. All three measures--hands-on tests, written tests, and training grades--were generally consistent measures of performance. A preliminary set of ASVAB qualification standards for assigning recruits to these three skills was computed using the hands-on and written tests as the criterion measure. The ASVAB standards derived from this analysis are similar to the standards based on the traditional criterion measure of training-course grades. We conclude that validating ASVAB enlistment standards against job performance appears to be feasible. Although job performance tests can be used for this purpose, they are costly to develop and administer. Training grades, which are routinely available, may serve as a satisfactory and economical proxy for them in many skills.

EXECUTIVE SUMMARY

INTRODUCTION

Each year the military services test approximately one million applicants for enlistment, and of these about one quarter fail to meet the mental standards. Mental standards are defined in terms of educational level (standards for high school graduates are lower than for nongraduates) and scores on the Armed Services Vocational Aptitude Battery (ASVAB).

Questions about the appropriateness of mental standards have arisen because of problems with ASVAB scores. In the late 1970s ASVAB scores were seriously inflated because of an error in calibrating the test. As a result, the standards were inadvertently lowered, and the services enlisted many people who would have failed to qualify if the ASVAB scores as reported had accurately measured mental aptitudes. When the problems with the scores became widely known, the Congress and Defense personnel managers wanted to know the effects of the inflated ASVAB scores on job performance. In effect, the question was whether the influx of people who should have failed to qualify seriously affected job performance. When the personnel managers turned to the ASVAB research analysts for answers, they found that whereas the ASVAB was known to be a valid predictor of grades in training courses, not much was known about the relationship between the ASVAB and job performance.

A large joint-service research program was then initiated to determine whether enlistment standards could be validated against job performance. The research task is to develop measures of job performance and to determine how well the ASVAB predicts scores on those measures. If the research demonstrates that the ASVAB predicts job performance, then enlistment standards can be validated against job performance.

PURPOSE

The purpose of this study was to evaluate the feasibility of validating the ASVAB against measures of job performance. The objectives of the study were to determine:

- The ability of the ASVAB to predict job performance
- The relationship between job performance tests, which are expensive to develop and administer, and other indicators of performance that are less expensive to obtain, notably training grades
- ASVAB qualification standards that would result from using measures of job performance as the criteria for validating the ASVAB.

The benchmark measures of job performance in the joint-service research program are job-sample tests that involve hands-on performance of tasks representative of all the important tasks in a job. Other measures or indicators, such as written tests of job skills and knowledge and training grades, are evaluated by their degree of relationship to the benchmark hands-on tests. To the extent these proxy measures are related to the hands-on tests, they can be used to supplement or serve as substitutes for the costly hands-on tests.

PROCEDURES

Three representative Marine Corps job skills were selected: Ground Radio Repair, Automotive Mechanic, and Infantry Rifleman. These skills vary widely in their job requirements. The Ground Radio Repair specialty has high technical demands (37 weeks of formal school training), Automotive Mechanic has moderate demands (13 weeks of training), and Infantry Rifleman has relatively low technical demands (5 weeks of training). For each specialty, Marine Corps job experts, assisted by testing psychologists, developed a hands-on test and a written test. The tests were administered by the Marine Corps to people in each specialty. Training course grades, routinely available in the Marine Corps, were also collected.

RESULTS

ASVAB as a Predictor of Job Performance

The primary objective of this study was to evaluate how accurately the ASVAB predicts job performance. If the ASVAB is an accurate predictor, it can be used confidently to set mental standards. The ASVAB did prove to be a valid predictor of hands-on performance tests in all three skills. The validity of the relevant ASVAB aptitude composite for each specialty is shown in table I. The validity coefficients are close to .6. The percent of satisfactory performers in 10-point intervals of ASVAB aptitude composite scores is shown in figure I.

Relationship of Proxy Measures to Hands-on Tests

The second objective was to evaluate proxy measures of performance (written tests and training grades) in terms of their relationship to the benchmark hands-on job performance tests. The correlation of the proxy measures with hands-on tests is shown in table II. For the two technical skills (Ground Radio Repair and Automotive Mechanic), the written tests and training grades show promise as substitutes for the hands-on tests. For the Infantry Rifleman skill, the written test shows promise as a substitute for the hands-on test, but because of lower correlation with the hands-on test, training grades show less promise.

TABLE I

VALIDITY OF THE ASVAB AS A PREDICTOR OF JOB PERFORMANCE

Skill	Validity[a] coefficient
Ground Radio Repair	.59
Automotive Mechanic	.56
Infantry Rifleman	.58

[a]Validity of appropriate ASVAB aptitude composite for predicting hands-on job performance test scores.

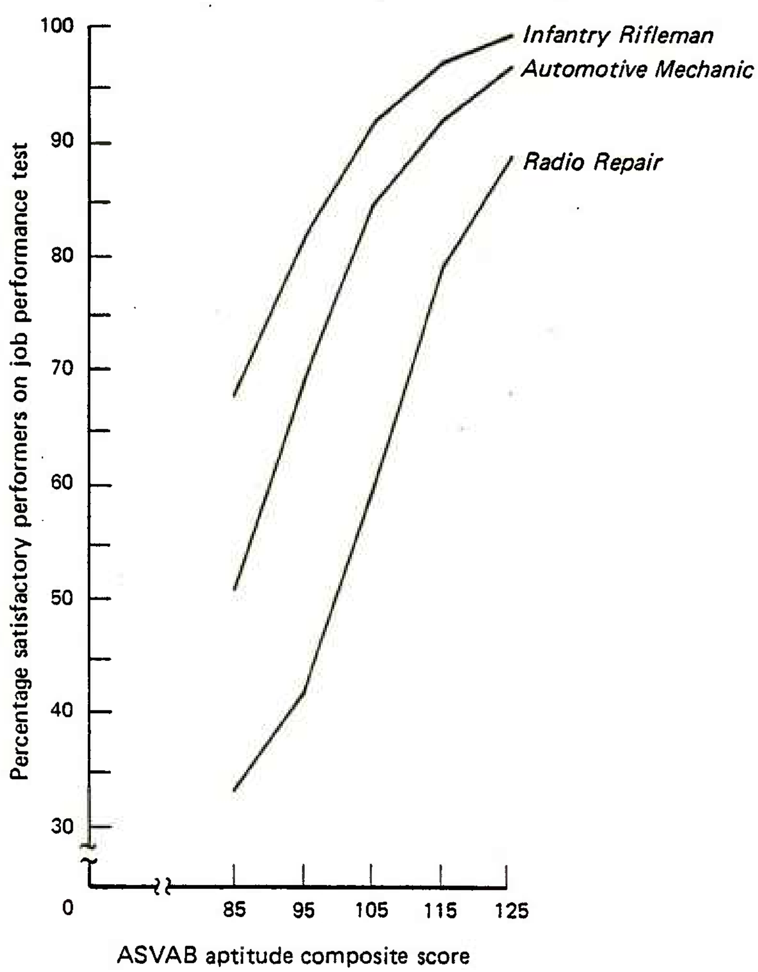

FIG. I: PERCENT SATISFACTORY PERFORMERS ON JOB PERFORMANCE TESTS BY ASVAB APTITUDE COMPOSITE

The validity of the appropriate ASVAB composites for predicting the proxy measures is also shown in table II. Except for training grades in the Infantry Rifleman skill, the ASVAB validity coefficients are high (.65 or higher).

TABLE II

CORRELATION OF PROXY MEASURES OF JOB PERFORMANCE WITH HANDS-ON TESTS AND THE ASVAB

		Correlation with:	
Skill	Proxy measure	Hands-on performance test	ASVAB aptitude composite[a]
Ground Radio Repair	Written test	.51	.73
	Training grades	.52	.75
Automotive Mechanic	Written test	.45	.65
	Training grades	.51	.83
Infantry Rifleman	Written test	.56	.69
	Training grades	.39	.29

[a]Correlation with appropriate aptitude composite.

Qualification Standards

The third objective was to evaluate the ASVAB qualification standards that would result from using job performance as the criterion for validating the ASVAB. Three pieces of information were required for this preliminary evaluation:

- Assumptions about the percent of the total population that would be satisfactory performers in the skills
- Acceptable rate of unsatisfactory performance in the skill among those qualified on the ASVAB
- Predictive validity of the ASVAB.

Assumptions About the Percent of Satisfactory Performers

Based on the experience of the military services and civilian world of work, we assumed that 50 percent of the population would be satisfactory radio repairers, 70 percent would be satisfactory automotive mechanics, and 80 percent would be satisfactory infantry riflemen. These percentages reflect the relative difficulty of the skills.

Acceptable Rate of Unsatisfactory Performance

The second piece of information reflects the cost that the Marine Corps, or any employer, is willing to bear to train or keep people on the payroll who are unsatisfactory performers. We assumed the Marine Corps would tolerate a failure rate of 10 percent (either in training or on the job or some combination of the two).

Predictive Validity of the ASVAB

The third piece of information is the predictive validity of the ASVAB in the full population. We used a combination of hands-on and written proficiency tests as the criterion measures of performance because both have content validity.

Qualification Standards Derived in This Study

Table III shows the qualification standards on the appropriate aptitude composites that were derived in this study. The similarity of these qualifying scores to those currently used supports the reasonableness of existing ASVAB qualification standards based on the traditional criterion measure of grades in skill training courses.

TABLE III

ASVAB QUALIFICATION STANDARDS

	Qualification standards[a]	
Skill	Existing	Derived
Ground Radio Repair	115	115
Automotive Mechanic	90	95
Infantry Rifleman	80	85

[a]Existing standards are for high school graduates; derived standards were estimated in this study.

FUTURE RESEARCH

The usefulness of the ASVAB for selecting and classifying recruits is supported by this study. The close correspondence of ASVAB qualification standards based on the hands-on and written proficiency tests with the traditional standards, based on training grades as the performance measures, should serve to increase confidence in using the ASVAB for selecting and classifying recruits.

Additional research is required to establish more firmly the credibility of training grades as performance measures for validating ASVAB. If training grades are found to have adequate content validity across a broad range of military skills, then the ASVAB can continue to be validated against them. They have the advantage that they are readily available for virtually all recruits, in contrast to the job performance measures, which are expensive to develop and administer. The cost to develop, administer, and analyze each of the job performance measures in this study was approximately $360,000. This cost is minimal because this effort was a feasibility study. In more definitive studies, the development of the performance measures will be more systematic, and the costs will be considerably higher. For skills in which training grades do not have content validity, hands-on or written proficiency tests may need to be developed. The joint-service research program to validate the ASVAB against job performance is addressing the credibility of proxy performance measures.

CONCLUSIONS

- The ASVAB is a valid predictor of job performance.
- Enlisted qualifying standards can be validated against job performance.
- Qualifying standards derived by using job performance as the criterion measure are similar to current Marine Corps standards.
- In technical skills, training grades that have been routinely available for recruits, and therefore are an economical criterion measure, appear to be about as satisfactory as job performance tests for validating qualification standards.
- For nontechnical skills, job performance measures may need to be developed for validating qualification standards.

RECOMMENDATIONS

- Additional Marine Corps jobs should be examined to determine if the conclusions in this report can be generalized.
- Numerical grades in job training courses, rather than simple pass/fail grades, should be routinely recorded and retained for use as criterion measures in future research efforts to validate the ASVAB.

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CHAPTER 1

EVALUATION OF PERFORMANCE

INTRODUCTION

When forms 5, 6, and 7 of the Armed Services Vocational Battery (ASVAB 5/6/7) were introduced on 1 January 1976, enlistment standards were inadvertently lowered. The score scale for ASVAB 5/6/7 was inflated compared to the traditional meaning of ASVAB scores. ASVAB 5/6/7 was used through September 1980. During that time, about 25 percent of the recruit accessions would not have qualified for enlistment if the tests had been accurately calibrated to the traditional ASVAB score scale.

New versions of the ASVAB, forms 8, 9, and 10 (ASVAB 8/9/10), were introduced on 1 October 1980. Because ASVAB 8/9/10 was accurately calibrated to the traditional score scale, enlistment standards would have been higher if the same nominal standards used with ASVAB 5/6/7 had remained in effect. When ASVAB 8/9/10 was introduced, all services except the Marine Corps lowered enlistment standards to about the same level that the actual standards had been with ASVAB 5/6/7. Thus, by maintaining the same nominal standards, the Marine Corps in effect raised the minimum qualifying scores for enlistment.

While ASVAB 8/9/10 was being prepared for operational use, personnel managers in the Department of Defense (DoD) became concerned about what the enlistment standards ought to be. The intent of enlistment standards is to prevent potential unsatisfactory performers from entering the service. DoD personnel managers wanted to know how well the ASVAB identifies applicants for enlistment who would have unsatisfactory levels of performance in their military jobs.

The personnel managers turned to the ASVAB research community for information about the relationship between ASVAB scores and job performance. The ASVAB and previous versions of military selection and classification test batteries have been extensively validated as predictors of success in skill training courses, but there have been no large-scale efforts to relate ASVAB scores to job performance. Because success in skill training courses has not been systematically related to job performance, the relationship between ASVAB and job performance remains questionable. The research community could not document the ASVAB as a valid predictor of performance on the job. As a result, the Office of the Assistant Secretary of Defense for Manpower, Reserve Affairs, and Logistics (ASD(MRA&L)) requested each service to validate ASVAB-related enlistment standards against performance on the job.

In this chapter, we discuss some of the issues in measuring job performance and in defining the content of performance measures. We

then describe the research design for evaluating the credibility of the performance measures and the validity of the ASVAB as a predictor of job performance. This chapter is longer than a customary chapter of introduction for several reasons. First, measures used and procedures followed to validate ASVAB need to be explained in detail because the exercise of validating is not carried out often on a regular basis. Second, developing and administering tests is a complex process, which also needs to be explained in detail. And, third, to set the tone for the work that follows we need to explain some of the pitfalls in constructing and analyzing performance measures.

MEASUREMENT OF JOB PERFORMANCE

A major reason the ASVAB has not been systematically validated against job performance is that measuring performance on the job is inherently difficult and expensive. Until recently the services, as is true for most employers, were unwilling to fund the cost of developing and administering measures of job performance. In part because of the problem with the inflated ASVAB scores and the ensuing concern about enlistment standards, the services are currently willing to explore the feasibility of validating ASVAB enlistment standards against job performance.

Performance and Proficiency

On the surface, job performance appears to be a simple concept that is readily observable and quantifiable; people are performing in their jobs or skills, and the level of performance should, theoretically, be readily ascertainable. In practice, records of performance by individual workers usually are not available, or if they are, the entries are not reliable. Furthermore, the definition of the term performance is itself not precise.

Performance is frequently thought to be identical to proficiency. Proficiency, as generally used in DoD, refers to competence--ability to perform job tasks; proficiency tests measure the skills and knowledge required to perform job tasks. Level of proficiency typically is measured in an explicit testing environment, using instruments specifically developed to measure competence on a set of job skills and knowledge. The examinees know they are being tested, and the scores reflect competence as demonstrated in a testing environment rather than typical performance in the natural job environment. Performance in DoD usage may refer to competence as demonstrated on proficiency tests, or it may refer to how well a person typically performs in the natural job environment.

In this report we attempt to maintain a distinction between proficiency and performance. When referring to proficiency, we mean competence as demonstrated on explicit measuring instruments; these instruments could be administered as special tests on the job site or

during a job training course. In either case, the examinees know they are being tested and evaluated. The word performance, however, is such a general term that we cannot use it consistently. Sometimes it refers to a type of measurement. A performance test usually means a job-sample test for which the examinees actually perform a set of job tasks. Performance tests usually imply hands-on testing, but not always. Sometimes performance is used generically to encompass what workers do, such as job performance. Because performance is such a general term and no other suitable term is available, the ambiguity remains, and in this report the context will help define how we use the word.

Requirements of Performance Measures

The fundamental requirement of job performance measures is that they should be relevant to job requirements. The content of the measures should reflect the content of the job; the closer the correspondence, the greater the "content validity" of the measure. Content validity is determined by expert judgment. Workers known to be proficient in the job evaluate the relevance of the measuring instruments to job requirements. Hands-on proficiency tests, in which examinees perform tasks encountered on the job, have a high degree of content validity. In fact, hands-on proficiency tests are the benchmark criterion by which the job relevance of other types of proficiency or performance measures is evaluated.

Another requirement for performance measures is that the scores accurately reflect the level of performance of the examinees. To the extent that the scores are accurate, they can be reproduced in other testing situations. With hands-on proficiency tests, the scores are accurate if different test administrators would assign the same scores or if the examinee would attain the same score when retested on another occasion.

Hands-on proficiency tests are the core performance measures. Because they have such a high degree of content validity they are the basis for evaluating the job relevance of other performance measures. Hands-on tests, however, generally suffer from a lack of scoring accuracy. The rules for administering and scoring hands-on tests cannot be explicated with sufficient clarity to ensure objective scoring; the test administrator invariably has latitude to exercise subjective judgment about what kinds of cues or hints to provide examinees and what standards to use to determine satisfactory and unsatisfactory levels of performance. Hands-on proficiency tests consist of a series of steps in performing a task. The administrator must decide whether the examinee has accomplished each step properly. In spite of the limitations arising from subjectivity in scoring, the content validity of hands-on tests still is the overriding consideration for determining the job relevance of other types of performance measures.

Types of Performance Measures

In our analysis, we included three types of performance measures. Two measures--the hands-on and written tests--were constructed specifically to reflect job requirements in the skill. The other, training grades, should reflect job requirements. Because they are related to the same job requirements, they should be related to each other. Each of these measures has advantages and disadvantages.

Hands-on Proficiency Tests

We have already discussed the primary advantage of hands-on proficiency tests--their content validity. Their disadvantages are the questionable scoring accuracy and, more important, the high cost of administering them. Hands-on tests require administrators who are themselves experts in performing the tasks, and who can make accurate decisions about the performance of examinees. Typically, in hands-on testing an administrator can test only one examinee at a time. In addition, the tests ordinarily require expensive equipment be set aside. Because of the resource demands placed on field units to provide experienced test administrators and equipment, the services have been reluctant to support large-scale administrations of hands-on tests.

Written Proficiency Tests

For years some services have used written proficiency tests to help evaluate job competence of enlisted personnel. Because of their paper-and-pencil format and multiple-choice items, their relevance to job requirements is questionable. Through careful preparation, written tests can require examinees to demonstrate many of the skills and knowledge required to perform job tasks. For example, written tests can require examinees to make the same kinds of decisions and perceptions they are required to make on the job. Written tests can also test only trivial facts that experienced workers may know, but are not required for performance of tasks. The latter type of test is much easier to construct and, unfortunately, all too often has been the type constructed. Written tests that focus on trivia and theory do lack content validity, and thereby cast doubt on the content validity of all written proficiency tests.

Written tests with content validity are expensive to construct. Job experts should provide the content, and other job experts should review the test items to make sure that the items measure skills and knowledge used on the job. The test should also be taken and critiqued by representative workers to make sure that the language is suitable. The key to content validity of written tests is that the examinees be required to apply their knowledge and skills to solving the same kinds of problems they encounter when performing job tasks.

Training Course Grades

Grades in skill training courses have served as the traditional criterion measures for validating ASVAB and previous military selection and classification test batteries. Training grades had the advantages that they were routinely available for almost all recruits, and they were based on objective evaluations of performance in job training programs. Their main disadvantage is questionable content validity. Just as written proficiency tests can include trivia and unnecessary theory, so can training courses. Training courses are sometimes criticized for emphasizing memory and verbal ability rather than competence to perform job tasks.

The training grades included in this analysis are based on traditional methods of instruction. The grades are based primarily on the percentage of test items answered correctly, where tests were administered at the end of instructional units and at the end of the course. Because they have the same characteristics as the traditional criterion measures for validating ASVAB, whatever we learn about their job relevance in this study should generalize to the meaning of training grades in prior validation efforts.

Training courses in all services are being revamped to conform to the Instructional System Design or Development (ISD) model, and the meaning of course grades is changing. The core of the ISD model is that training course content should be based on job requirements. Normally, in revamped courses, the training and testing to evaluate student proficiency both use the hands-on mode. Students practice performing job tasks, and then they are tested on how well they perform the same tasks. The training objectives are clearly specified in performance terms, and typically student performance is reported simply as pass or fail (ISD terminology is GO/NO-GO). Information about the rank order of students, such as percentage of steps passed on the first attempt to complete an instructional module, is not reported. For validation purposes, the pass-fail scoring is not adequate. Validation requires that information about individual differences in level of achievement be available. Individual differences in the predictor scores are then related to individual differences in achievement. The higher the relationship, the more valid the predictor test.

Our analysis of training course grades to determine their usefulness as criterion measures of job performance may not generalize to the new type of training courses. Because of the changes in the revamped courses following the ISD model, the job relevance of the grades could be higher or lower. The content of the course suggests higher job relevance, but the pass-fail scoring dilutes the usefulness of training grades as criterion measures. The relevance of both types of training grades to job performance remains to be determined.

Ratings of Job Proficiency

Ratings by supervisors are the time-honored means for evaluating performance of workers. Most personnel decisions based on quality of performance include supervisor ratings. Because ratings are used so pervasively, it is natural to question why they are not adequate measures of performance for validating the ASVAB and enlistment standards. The answer rests on their questionable relevance to job requirements and the low accuracy of their scores.

In general ratings are subjective evaluations that may include a component of competence to perform job tasks; but they may also reflect other components such as cooperativeness, personal appearance, and punctuality. Rating scores tend to fluctuate from rater to rater, or even from time to time for the same rater. Just as hands-on tests require judgment in scoring, so do ratings incorporate judgments with even less precise rules for assigning scores. Contrary to hands-on tests that have high job relevance, ratings usually do not compensate for their questionable scoring accuracy with high content validity. For these reasons, we did not include supervisors' ratings in our analysis.

We used three types of performance measures--hands-on proficiency tests, written proficiency tests and training course grades--as the criteria for validating the ASVAB in our study. The hands-on and written proficiency tests were developed especially for this study, but the training grades were obtained from Marine Corps records. We developed proficiency tests for three skills: Ground Radio Repair, Automotive Mechanic, and Infantry Rifleman. In the following section, we discuss some issues in deciding on the content of the proficiency tests.

CONTENT OF PROFICIENCY TESTS

The starting place for determining content of the proficiency tests is, of course, job requirements. After that general statement, divergent points of view abound about how to define job requirements. One point of view is that the content should be based on the specific requirements in a specific duty assignment. In all services, a person is assigned to fill a particular position, and from this point of view, content of the proficiency tests should be based on the requirements for a particular individual in a particular assignment. A second point of view is that the content should enable generalization from the content of the measures to performance on all requirements in the skill. Another consideration is whether the content should cover peacetime or combat requirements. The positions are not necessarily mutually exclusive and there are arguments to support each point of view.

Limit Content to a Specific Duty Assignment?

In the civilian economy, a set of job requirements usually defines the responsibility of workers, and workers are evaluated by managers

according to how well they carry out their assigned responsibilities. In the military services, management of workers ordinarily is by skill rather than by specific duty assignments, where duty assignments correspond to jobs in the conventional sense. Recruits are trained to perform in a skill, which covers a variety of duty assignments. Service personnel ordinarily are eligible for assignment to any duty position within the skill. Hence, the question arises whether the content should be specific to the job assignment or be representative of the skill.

If the performance tests are to describe how well workers are performing at a fixed point in time, say 1 year after completion of skill training, then a reasonable approach is to define content in terms of specific job assignments. Or, if we want to know how well examinees are contributing to the effectiveness or readiness of their units, then content should be limited to the assignments. Another argument is that the best predictor of future performance is present performance. At the very least, performance tests should be relevant to requirements in the examinees' current assignments.

Generalize to Requirements in the Skill?

Because the purpose of the performance measures used in this study is to serve as criteria for performance in the skill, we must be able to generalize to requirements for the entire skill. The only question is how.

The safest and simplest way is to develop the performance test content to facilitate generalizing to the skill. All important content areas of the skill should be included in the tests. The hands-on and written proficiency tests used in this study were designed to represent the critical requirements in the skill.

In addition to covering the important content areas of the entire skill, generalizing is facilitated by having all examinees respond to the same test content. The performances of examinees then can be compared directly with each other because they are on the same score scale. Although measures designed to cover the requirements for a particular assignment may also serve as measures for generalizing to the skill, the measurement problems are momentous. In the final chapter we discuss some problems of scaling measures that have different content.

Peacetime or Combat Requirements?

Although the obvious position is to include combat requirements, this solution generally is not feasible. For technical skills, such as radio repair and mechanics, the tasks are similar in peacetime and wartime, and the main difference is in the working conditions. For combat arms skills, such as rifleman, job requirements are somewhat different, as well as the conditions under which tasks are performed.

If combat requirements are incorporated into the measures, then combat conditions must be simulated.

Some of the combat requirements are that the tasks be performed in the vicinity of an intelligent foe, i.e., one who is able to take aggressive action against the examinees. Also, the physical stress of combat should be built into the measures. Ordinarily, the services are not willing to expose examinees to the risks of realistic combat conditions. Furthermore, combat conditions are expensive to simulate. From a measurement point of view, combat conditions tend to destroy standardized administration and scoring procedures. For at least these reasons, performance measures usually include peacetime requirements, with attempts to incorporate combat conditions as feasible.

How to Attain Content Validity?

The steps in constructing proficiency tests involve a close working relationship between measurement and job experts. Job experts provide the crucial information about job requirements ranging from the broad content areas through the tasks in each area to the wording of test items or steps in a task. Job experts should ensure that, to the extent feasible, job requirements are realistically incorporated into the tests. Measurement experts provide guidance about structuring the job requirements into items or steps, evaluating the tests through review by panels of job experts, and tryout with representative examinees. Job experts should play the central role in developing proficiency tests.

Job experts with different points of view should be consulted during development of the tests. One reason is to ensure that all critical content areas are covered and in proper balance. They also should play a vital role in ensuring that the details of the tests conform to job requirements. One consideration is that the language and concepts of written tests conform to ordinary usage of workers in the skill. Another is that the tasks of hands-on performance tests are structured similarly to the way they are typically performed. If the details deviate from job requirements, content validity is lowered.

A fault that occurs frequently in proficiency tests is that examinees are asked to tell what they know about the job rather than to demonstrate that they know how to perform tasks. Written tests especially can focus on abstract facts and principles, rather than requiring examinees to apply their knowledge in practical situations. A good strategy is to present a work situation and ask the examinees what they would do if they encountered specific conditions. Even hands-on performance tests can err by focusing on trivial tasks, and they may reflect procedures different from those workers typically use. For example, the training course may teach one set of procedures for performing a task, but in the field environment different procedures may be used. The test should be based on the procedures used in the field rather than those

taught in the classroom. Job experts should be alerted to these problems, and the content should be reviewed at all levels of detail.

In this study, the purpose of the performance evaluations is to serve as criterion measures for validating the ASVAB. As criterion measures, the evaluation scores must have measurement accuracy. To gain accuracy--standardized testing conditions and reproducibility of the scores--we must sacrifice some content validity. Some realism of job requirements, such as an unstructured working environment, must be lost. For other purposes, such as identifying training deficiencies, content validity is more important, and some scoring accuracy may be sacrificed to achieve greater realism. The content of the performance tests used in this study is a reasonable compromise that balances realistic job requirements, working conditions, and scoring accuracy.

RESEARCH DESIGN

The research design was intended to provide data on the predictive validity of the ASVAB across a broad range of job requirements. We evaluated the effects of combining the performance measures in different ways to determine whether the use of alternative criterion measures would result in selecting the same or different people. The analyses in this report were directed toward the establishment of qualifying prerequisite aptitude composite scores in each skill. Subsequent analyses will address the question of how to combine the information for each skill and establish enlistment standards.

Skills Used in the Study

The skills used in the study range from high to low in their technical complexity. The most technically demanding skill is Ground Radio Repair. Radio repairers in the Marine Corps perform many troubleshooting tasks. Troubleshooting requires first, knowing how the equipment functions, second, applying the knowledge to diagnose malfunctions, and third, taking appropriate corrective action. The skills and knowledge are primarily mental, or cognitive; psychomotor skills and manual dexterity are also required to use hand tools, such as soldering in tight spaces. The formal school training for the Ground Radio Repair skill lasts about 37 weeks.

The skill with intermediate technical demands is the organizational level Automotive Mechanic. The organizational level mechanic tends to perform the more routine tasks, such as engine tune-up and removing and replacing parts. Complex repair tasks, such as overhaul of the transmissions, are performed at higher levels of maintenance. Automotive mechanics must have some knowledge of how the various systems of a vehicle function; they must also be proficient in the use of tools and equipment. Mechanics tend to have a balance of cognitive and psychomotor demands placed on them. Their formal school training lasts 13 weeks.

Of the three skills, Infantry Rifleman places the least technical demands on incumbents. Riflemen must have physical stamina and enough strength to carry heavy loads. They must have psychomotor skills, such as marksmanship and first aid. Although they must have some cognitive skills, as in land navigation, first aid and communication signals, most of the technical complexity is handled by squad leaders and higher ranking personnel. The formal school training for Riflemen lasts 5 weeks.

The hands-on and written proficiency tests for these skills take different forms; the content is described next. The three skills also may differ in the degree to which performance is predictable by the ASVAB. The ASVAB consists largely of items that tap cognitive skills (vocabulary, arithmetic and mathematical problems, and knowledge of technical fields). Our expectation is that performance in the Infantry Rifleman skill is least predictable by the ASVAB, and the Ground Radio Repair is most predictable.

Description of the Proficiency Tests

Hands-on and written proficiency tests were developed for each skill. The tests were developed by Marine Corps job experts, with technical assistance from the Navy Personnel Research and Development Center (NPRDC). The test development is described in an NPRDC report [1], and details are presented in appendix A.

The tests are obtrusive measures of proficiency in the sense that the examinees knew they were being tested. They were not informed beforehand, however, about the content of the test. The examinees were instructed to refrain from discussing the test content with other Marines who would be tested later. The tests, therefore, are intended to reflect the skills and knowledge of the examinees under standard testing conditions, rather than their level of performance in the normal work environment.

Ground Radio Repair Proficiency Test

The written portion of the radio repair test consisted of 59 items and required 2 hours of testing time. The written test had four sections:

- General topics, 22 items--use and function of equipment and calculating quantities for simple circuits
- Meters, 18 items--use, function, and setting up
- Oscilloscopes, 12 items--use and function

- AN/UIQ-10, 7 items--troubleshoot an unfamiliar piece of equipment from description of symptoms, using technical manuals and troubleshooting charts.

The testing time was 75 minutes for the first 52 items and 50 minutes for the last 7 items, which required extensive looking up of information about the equipment.

The hands-on test consisted of troubleshooting 10 circuit boards. A total of 210 minutes, with up to 30 minutes for each board, was allowed for the hands-on test. Some examinees were not able to work on all boards because of the total time limit. For each board, the examinees were to identify the faulty symptom (worth 2 points), circuit (4 points), and component (up to 8 points). Examinees were encouraged to guess when they had narrowed the choice of circuits and components.

The hands-on test involved the use of meters, signal generator, and oscilloscope to troubleshoot the circuit boards. The examinees could use the technical manuals and troubleshooting charts for the equipment. None of the examinees had ever worked on this piece of equipment before. The test therefore tapped their ability to apply their skills and knowledge in a novel situation.

Automotive Mechanic Proficiency Test

The written portion of the automotive mechanic test required 2 hours of testing time and consisted of 61 items. The first 23 items covered the following systems, with special reference to the M151 quarter-ton vehicle (Jeep):

- Fuel and electrical--12 items
- Steering--3 items
- Cooling--8 items.

The remaining 38 items covered the M54 5-ton multifuel vehicle. Examinees could consult technical manuals during the test.

The hands-on test consisted of four tasks on the M151 vehicle and required up to 3-1/2 hours:

- Major engine tuneup--2 hours
- Alternator output and battery--30 minutes
- Wheel and brake maintenance--60 minutes
- Equipment repair order--embedded in the other tests.

Each part of the hands-on test consisted of steps, with each step scored pass or fail. The score is the number of steps passed for each part. The test administrators provided prompts to examinees when they were stuck on a step. Administrators exercised their own judgment about scoring each step as pass or fail. No systematic instructions were provided about the amount of assistance to provide, how to score the step when prompts were provided, or how to record the fact that prompts were given. Scores on the hands-on test therefore may vary because of the varying amounts of help given by the administrators.

Infantry Rifleman Proficiency Test

The written test for the infantrymen had 100 points and required 30 minutes to administer. It covered the following topics:

- Infantryman weapons and duties--11 points
- Weapon characteristics--17 points
- Combat intelligence and prisoner handling--29 points
- Acronyms--24 points
- NBC defense--13 points
- Identification of tracked vehicles and aircraft--6 points.

The number of items does not correspond to the number of points because complex weighting schemes were used to assign points.

The hands-on test had seven tasks, worth a total of 332 points, and required about 4 hours. The tasks and points for each are:

- Map and compass--85 points
- First aid--43 points
- Fire team formations--27 points
- Mines and booby traps--67 points
- Target engagement--110 points.

The number of points includes negative scores for serious errors, such as firing on friendly targets or inability to tell which direction is north by reading a compass.

Background and Job Experience of Examinees

Examinees completed a brief questionnaire about the amount and type of their training and job experience. Examinees in all three skills were asked how many months they had of relevant job experience since completing formal training. The automotive mechanics were also asked about the amount of their paid civilian experience as mechanics.

Data Collection Procedures

All proficiency tests were administered at Camp Pendleton, CA. The test administrators were senior Marine Corps enlisted personnel with job experience in their field. Most examinees were stationed at Camp Pendleton, but radio repairers and automotive mechanics were also obtained from other Marine Corps locations in Southern California. All testing for each examinee was accomplished in 1 day. The test administrations were conducted from August through November 1981.

Proficiency Tests

All parts of the hands-on tests in the Radio Repair and Mechanic skills for any one examinee were administered and scored by the same administrator. Whatever effect an administrator had on the test scores, such as giving prompts about the correct action to take, was the same for all parts of the hands-on test for each examinee.

For the Infantry Rifleman skill, the test administration procedures were different. The hands-on test for the infantryman was divided into a series of testing stations. Each station as a rule was handled by a different test administrator. On occasion, the same administrator handled several stations for some examinees. The administrators sometimes also moved to different testing stations on different days. The effects of test administrators on the scores for infantrymen did not consistently raise or lower the total hands-on scores for any one examinee.

For the Radio Repair and Mechanics skills, the effects of test administrator on the hands-on scores can be computed; but for the Infantryman skill, the complex testing arrangements preclude computing the effects of test administrators on the hands-on scores.

As we mentioned when discussing hands-on proficiency tests, the scoring of hands-on tests requires expert judgment. Experts tend to disagree about scoring standards and about how to handle the examinees, including the amount and type of prompting. These differences among administrators introduce unwanted variation into examinees' scores. Ideally, the scores should reflect the competence of examinees and nothing else. To the extent that some examinees' scores are raised or lowered because of the administrator, the test scores contain error. The differences among administrators should be statistically removed

from hands-on scores prior to computing their relationship to other scores.

Another possible source of error arises from poor test security. Because only a few examinees can be tested at a time, and administrations are spread over weeks or months, examinees tested later in the schedule may have had an opportunity to practice performing the tasks in the hands-on test and learn the answers to the written test items. To minimize leaks about test content, examinees were admonished to refrain from discussing the test with other potential examinees. To the extent that some examinees had prior knowledge and others did not, differences in scores will be misleading.

Written proficiency tests were administered on the same days as the hands-on tests. Scoring of both the hands-on and written tests was done centrally by CNA rather than locally by test administrators.

Training Grades

Following completion of the testing, we attempted to collect training grades from the Marine Corps schools where the examinees received their skill training. Many of the examinees had graduated from their skill training courses several years earlier, and the schools no longer retained the records. As a result, the samples were reduced because of missing grades.

ASVAB Test Scores

We also collected ASVAB test scores for the examinees following the completion of testing. Again, we lost cases because some examinees were enlisted before ASVAB 5/6/7 was introduced (January 1976). We lost more cases because of incomplete information about ASVAB scores. Some examinees were missing one or more subtest scores, and we deleted them from the analysis.

Most of the cases lost were because of missing training grades. Had we been able to maintain a large sample size by obtaining more ASVAB scores, we could have retrieved more of these data. But because of the large number with missing training grades, we decided not to engage in an expensive clerical search for more complete records of ASVAB scores.

Statistical Analysis

Each skill was analyzed separately. The first objective was to establish the construct validity of the performance measures. For our purposes, the construct validity of the performance measures is established when we determine that all the measures are consistent indicators of performance. In the analysis, we start with the relationships among the units of tests that are scored separately. These units are the parts of the hands-on and written tests described earlier in the

section, Description of the Proficiency Tests. The correlation among the parts should be positive because each part is designed to measure a cluster of job requirements in the skill. A negative or zero correlation among the parts implies either that the content of that requirement is different from the other job requirements, or more likely, that the measurement properties of that part are faulty. In addition, we estimated the internal consistency reliability of the proficiency tests. The internal consistency reliability reflects the intercorrelation of the parts of items. We then proceeded to combine the parts to form larger units. Most of our analyses used the hands-on test score, written test score, and training grade for each examinee as the units of analysis. The intercorrelation among these three measures should be high. If the correlations are high, then they are measuring something in common. We infer that the common dimension among the measures is job performance. The construct validity of the measures is also supported by their correlation with relevant job experience and enlisted grade. As a rule, people with more experience and at higher enlisted grades should be more proficient in their jobs. More details about the statistical analysis are presented in appendix B.

In addition, the correlation between the performance measures and the ASVAB aptitude composites should conform to our a priori expectations. The predictive validity of the ASVAB aptitude composites is supported by more than 40 years of research and experience. If the performance measures are indeed measuring job performance, the Electronics Repair (EL) aptitude composite should have the highest validity of all the ASVAB composites for predicting performance in the Ground Radio Repair skill. Similarly, the Mechanical Maintenance (MM) composite should have the highest predictive validity in the Automotive Mechanic skill, and Combat (CO) in the Infantry Rifleman skill. If other aptitude composites have higher predictive validity, we suspect that the performance measure may, in fact, be measuring something other than job performance.

The analysis was directed toward examining patterns of relationships among the variables. No single statistic provides sufficient evidence to confirm or deny that a measure has adequate construct validity. If the pattern of relationships is consistent and conforms to our prior expectations, then we are more confident in inferring that the common dimension running through the measures is job performance.

The key to establishing the construct validity of the performance measures lies in the way they were constructed in the first place. Job experts must agree that the content of the measure is based on job requirements. Expert judgment establishes the job relevance of the measures. The statistical analysis cannot change the content; it can support that the measures are behaving as expected or that somehow the measures contain unsatisfactory degrees of error.

OVERVIEW

This introduction to job performance measures has been lengthy. One reason is that research efforts using hands-on performance tests as the criterion measures are done infrequently. Little work has been done to validate the ASVAB, or any other aptitude battery, as a predictor of objective measures of job performance. The measures and procedures needed to be described in more than the usual detail. A second reason is that developing and administering performance measures is a complex process. Many things can go wrong, and we have covered only the most salient sources of errors. The need for good performance measures has long been recognized by the personnel research community. The paucity of prior research is not an indication of lack of will or foresight; rather it attests to the complexity and expense of obtaining good measures of performance that have high manifest content validity. The Department of Defense is taking a bold step by requesting the armed services to validate their enlistment standards against job performance.

In chapter 2 we present evidence supporting the construct validity of the three performance measures. In chapter 3, we then use the performance measures to establish minimum prerequisite scores for assignment to these skills.

CHAPTER 2

EVALUATION OF PERFORMANCE MEASURES

INTRODUCTION

The purpose of evaluating the performance measures is to determine their credibility. Because each performance measure is a sample of job requirements in the skill, and because we need to generalize from performance on each measure to performance in the skill, each measure should be a consistent indicator of performance in the skill. We determine consistency by computing the intercorrelation among the measures. To the extent that the measures are positively intercorrelated, they are measuring the same thing, and they are consistent. We improve our estimate of performance in the skill by adding together measures that are consistently related to other measures. Each measure must, of course, first have content validity as judged by job experts. The statistical analysis examines their relationships to determine how well we can generalize from them to performance in the skill.

The first step in the analysis is to compute the correlation among the parts of hands-on and written proficiency tests. Job experts determined from a content point of view that each part is a component of performance in the skill. If a part is negatively related to other parts of the test, then the scores on that part are not consistent. In performance measurement, the direction of the correlation can be specified beforehand because job experts specify whether a high or low score is indicative of high performance. If after inspection the part appears faulty, it should be deleted from the test. We also computed the internal consistency to determine the extent to which test items or steps in the hands-on test are consistent indicators of performance in the skill. A high internal consistency index indicates that the measures are consistent evaluations of performance.

The second step is to examine the consistency among the performance measures and other indicators of performance. Again we look for positive correlation among the performance measures and with other indicators. The other indicators are enlisted grade and amount of job experience. People who have more experience working in the skill and whom the Marine Corps has rewarded by promotion in the skill should tend to have higher performance scores. Also, the pattern of correlation with ASVAB aptitude composites should conform to our expectations about the predictive validity of the composites. If the correlations do not conform to these expectations, we would suspect that the performance measures are measuring extraneous factors in addition to job competence.

The correlation coefficients for the samples of examinees in each skill underestimate the values for the full population of potential recruits. The examinees have undergone a double selection. First, they

had to attain qualifying scores on the ASVAB at the time of enlistment and assignment to training in the skill. Second, they had to pass the training course before they were allowed to work in the skill. The correlation coefficients among the performance measures and with other indicators of performance will be corrected for prior selection of examinees on the basis of their ASVAB scores. To the extent that ASVAB scores predict grades in skill training courses, the correction for selection on ASVAB scores also corrects for failure to complete the skill training course. The correction estimates the correlation that would obtain in the population of potential recruits.

INTERCORRELATION OF PROFICIENCY TEST SCORES

The intercorrelations presented in this section are based on the examinees who were administered the proficiency tests. The original intent was that the examinees would be stationed at Camp Pendleton and have from 6 to 18 months of job experience. Because there were not enough people assigned to the Ground Radio Repair or Automotive Mechanic skills at Camp Pendleton, Marines from other sites in southern California were brought there for testing. Only Marines assigned to these skills serving in their first enlistment or early in their second enlistment were given the proficiency tests. All examinees in the Infantry Rifleman skill were stationed at Camp Pendleton. Their job experience ranged from about 2 weeks in a unit to over 2 years.

Hands-on Tests

Ground Radio Repair

The hands-on test for the Ground Radio Repair skill consisted of ten defective circuit boards. The score for each board ranged from 0 to 14 (2 points for identifying the faulty symptom, 4 points for the faulty circuit, and 8 for the faulty component). In table 1 we show the intercorrelation of the ten circuit boards, the correlation of each board with the total hands-on score, and the intercorrelation of the symptom, circuit, and component scores, where each score is summed across the ten boards. The correlation coefficients of the parts were not corrected for selection of the examinees. All correlation coefficients are positive, which indicates that each board is a consistent indicator of performance. The intercorrelation of the symptom, circuit, and component scores is also positive. The magnitude of the coefficients is of less importance than their pattern. All coefficients should be positive; if negative, the value should be small. These results support the credibility of the hands-on test as a measure of proficiency.

The coefficients in table 1 are based on 154 Marines assigned to the Ground Radio Repair skill. The original sample consisted of 189 examinees, but 35 cases were deleted because their training and job experience were different from those of the 154 cases. The 35 cases are described in appendix B.

TABLE 1

INTERCORRELATION OF HANDS-ON TEST--GROUND RADIO REPAIR[a]

Circuit board	Circuit board 1	2	3	4	5	6	7	8	9	10	Mean score	Standard deviation
1	-	.43	.33	.21	.10	.09	.20	.21	.32	.31	12.4	3.1
2	.43	-	.42	.35	.09	.25	.16	.23	.34	.33	12.2	3.5
3	.33	.42	-	.35	.40	.30	.17	.38	.34	.37	10.4	4.3
4	.21	.35	.35	-	.34	.31	.23	.32	.39	.41	11.2	4.5
5	.10	.09	.40	.34	-	.25	.25	.36	.35	.37	11.7	3.5
6	.09	.25	.30	.31	.25	-	.16	.25	.17	.15	10.7	3.7
7	.20	.16	.17	.23	.25	.16	-	.39	.17	.30	11.3	4.2
8	.21	.23	.38	.32	.36	.25	.39	-	.32	.46	9.6	5.2
9	.32	.34	.34	.39	.35	.17	.17	.32	-	.54	11.5	4.5
10	.31	.33	.37	.41	.37	.15	.30	.46	.54	-	9.8	5.4
Total[b]	.49	.57	.66	.65	.58	.47	.51	.68	.66	.73	110.8	25.7

Stage of troubleshooting	Stage of troubleshooting the boards: Symptom[b]	Circuit[b]	Component[b]	Mean score	Standard deviation
Symptom	-	.54	.39	18.7	1.8
Circuit	.54	-	.76	35.9	5.5
Component	.39	.76	-	56.2	20.5
Total	.49	.86	.98	110.8	25.7

[a]Number of cases is 154.
[b]Score is sum of the ten circuit boards.

Automotive Mechanic

The hands-on test for the Automotive Mechanic sample consisted of ten parts. Their intercorrelation is shown in table 2. The sample consisted of 263 automotive mechanics. The correlation coefficients are positive, except for the plugs part. The plugs part was retained because the coefficents varied around zero, rather than a large negative value. The zero or small negative correlation is acceptable for parts of a test, but would be troublesome if found between the total scores, or between the hands-on and written tests. Given that the job experts had determined that automotive mechanics should know how to check spark plugs, we decided that the zero correlations did not warrant throwing out this part. The pattern of generally positive intercorrelation supports the credibility of this hands-on test as a measure of proficiency.

Infantry Rifleman

The intercorrelation of the hands-on test parts for the Infantry Rifleman skill is shown in table 3. The hands-on test has five parts, and all five are positively intercorrelated. Again, we conclude that the credibility of the hands-on test as a measure of job proficiency is supported.

Each of the three hands-on proficiency tests appears to be measuring something in common. The content validity of the hands-on tests, supported by the positive intercorrelation of the parts, suggests that we can use the hands-on tests to help evaluate the extent to which the other performance measures are in fact relevant to job requirements.

Internal Consistency of the Hands-on Tests

The internal consistency reliability index is a function of the intercorrelation among the parts or test items. To the extent that the parts or items are measuring the same thing, they are intercorrelated and the internal consistency index is high. We used special equations to compute the internal consistency of a composite [2]. The equation for the α index is the lower bound in that it does not consider the reliability of the parts. It is analogous to the conventional equation for computing the internal consistency of a test:

$$\alpha = \frac{n}{n-1}\left[1 - \frac{\sum s_y^2}{s_T^2}\right],$$

where:

α = the internal consistency reliability, ranging from 0 to 1.0

n = the number of parts or items in the test

TABLE 2

INTERCORRELATION OF HANDS-ON TEST--AUTOMOTIVE MECHANIC[a]

Part	Part of hands-on test									Mean score	Standard deviation
	Compression	Coil	Plugs	Vacuum	Timing	Repair order	Battery	Alternator	Wheel-brake		
Compression test	-	.39	-.02	.30	.41	.24	.27	.21	.31	7.5	0.9
Coil	.39	-	.00	.32	.27	.31	.36	.20	.23	16.7	2.8
Plugs	-.02	.00	-	.08	.06	.18	-.02	-.17	-.13	2.2	0.5
Vacuum test	.30	.32	.08	-	.41	.30	.38	.16	.17	3.8	0.6
Timing	.41	.27	.06	.41	-	.18	.23	.23	.18	6.5	1.3
Repair order	.24	.31	.18	.30	.18	-	.16	.10	.16	7.4	1.1
Battery	.27	.36	-.02	.38	.23	.16	-	.37	.43	9.3	1.5
Alternator	.21	.20	-.17	.16	.23	.10	.37	-	.33	7.0	1.8
Wheel-brake	.31	.23	-.13	.17	.18	.16	.43	.33	-	11.7	2.4
Total	.59	.72	.02	.52	.53	.46	.67	.56	.65	72.1	7.7

[a]Number of cases is 263.

s_y^2 = the variance of each part or item

s_T^2 = the variance of the total test.

TABLE 3

INTERCORRELATION OF HANDS-ON TEST--
INFANTRY RIFLEMAN[a]

Part		Part of hands-on test					Mean score	Standard deviation
		1	2	3	4	5		
1	Map and compass	-	.24	.42	.43	.15	34.2	15.2
2	First aid	.24	-	.17	.18	.06	16.5	5.7
3	Formations	.42	.17	-	.16	.06	14.5	5.6
4	Antitank	.43	.18	.16	-	.24	24.4	10.0
5	Firing	.15	.06	.06	.24	-	49.0	22.0
	Total	.71	.36	.42	.63	.73	138.6	37.6

[a]Number of cases is 384.

The second equation takes into account the reliability of the parts:

$$r_{tt} = \frac{\sum s_y^2 \, r_{yy} + \sum_{x \neq y} \mathrm{Cov}_{xy}}{\sum s_y^2 + \sum_{x \neq y} \mathrm{Cov}_{xy}} ,$$

where:

r_{tt} = the internal consistency of the composite

s_y^2 = the variance of part y

r_{yy} = the reliability of part y

Cov_{xy} = the covariance of parts x and y.

The estimated internal consistency of the hands-on tests using the two equations is

Skill	Internal consistency	
	α	r_{tt}
Ground Radio Repair	.81	.86
Automotive Mechanic	.60	.77
Rifleman	.47	.69

For computing r_{tt}, we assumed the reliability of each part to be .50, which is a conservative value. The variance of the parts and total scores used in the computations are shown in appendix C.

The internal consistency indexes indicate that troubleshooting the ten circuit boards in the Ground Radio Repair skill is a relatively homogeneous task, and the two indexes have similar values (.81 versus .86). The nine maintenance tasks in the Automotive Mechanic hands-on test are more heterogeneous, with values of .60 and .77, and the parts of the Rifleman test are the most heterogeneous (.47 and .69). By including estimates of the reliability of the parts for the Automotive Mechanic and Rifleman hands-on tests, the internal consistency indexes were increased appreciably. The relative magnitude of the internal consistency indexes conforms to the intercorrelations among the parts shown in tables 1, 2, and 3.

Written Tests

Ground Radio Repair

The intercorrelation of the parts of the written proficiency test for the Ground Radio Repair skill is shown in table 4. The four parts are positively intercorrelated. The internal consistency reliability of the written test is .83, when the test items are used as a unit. When the parts of the written test are used to estimate internal consistency, the α index is .54 and the r_{tt} index (assuming each part has a reliability of .50) is .70. The intercorrelation and reliability indicate that the scores of the written test are accurate measures of whatever it is that the test is measuring. In other words, we expect that the examinees would reproduce their scores reasonably well if tested again with a different set of test items. We conclude that the credibility of the written test as a measure of job proficiency is supported. However, because of its questionable content validity, we need to find how it correlates with the hands-on proficiency test and the other measures of performance before we can be more confident that it is in fact measuring job proficiency.

TABLE 4

INTERCORRELATION OF WRITTEN TEST--
GROUND RADIO REPAIR[a]

Part	Part of hands-on test 1	2	3	4	Mean score	Standard deviation
1 General	-	.30	.23	.31	15.4	3.1
2 Meters	.30	-	.24	.15	19.4	4.4
3 Scopes	.23	.24	-	.26	11.6	5.7
4 Troubleshooting	.31	.15	.26	-	9.0	4.3
Total	.56	.67	.75	.63	55.4	11.1

[a]Number of cases is 154.

Automotive Mechanic

The intercorrelation of the written parts for the Automotive Mechanic skill is shown in table 5. The items on the fuel and cooling systems and the 5-ton multifuel vehicle have a pattern of positive intercorrelation, but the items on the steering system have a low correlation with the other three parts. In general, the parts of the written test for the Automotive Mechanic skill are consistent measures. The internal consistency reliability of the test is .77 when the items are used as the unit. When the parts are used as the unit, the α index is .36, and the r_{tt} index (assuming the reliability of each part is .50) is .64. The written test for the Automotive Mechanics skill has sufficient credibility to warrant further analysis as a measure of performance.

Infantry Rifleman

The written test for the Infantry Rifleman skill consisted of nine parts. The nine parts have a pattern of positive intercorrelation (table 6). Only one part, handling of prisoners-1, has correlation coefficients close to zero. We did not attempt to compute the internal consistency reliability using items as the unit, because the complex scoring rules preclude using conventional formulas for computing test reliability. Using the part of the test as the unit, the α index is .66, and the r_{tt} index (assuming reliability of .50 for each part) is .77. The pattern of positive intercorrelation and the internal consistency indexes show that the parts are measuring something in common, and we can use the written test in the subsequent analysis.

TABLE 5

INTERCORRELATION OF WRITTEN TEST--
AUTOMOTIVE MECHANIC[a]

Part	Part of written test: Fuel	Steering	Cooling	5-ton	Mean score	Standard deviation
Fuel	-	.13	.20	.31	6.0	2.0
Steering	.13	-	.01	-.01	1.8	0.8
Cooling	.20	.01	-	.40	5.6	1.4
5-ton multifuel	.31	-.01	.40	-	20.0	5.8
Total	.56	.14	.55	.94	33.4	7.4

[a]Number of cases is 263.

The hands-on and written proficiency tests for all three skills have passed the first analysis to determine their credibility. The parts of each test have a satisfactory pattern of positive intercorrelation and satisfactory internal consistency reliability. In this first step of the analysis, we were looking for large negative coefficients that would point to faulty measures. Because we found none we combined the parts for each test to obtain measures that encompass more of the range of job requirements in each skill.

The intercorrelation of the parts is generally low, with only a few coefficients as high as .4 or .5. One reason they are low is that the parts are usually short and therefore unreliable. Another reason is that the samples included only people who were qualified to work in the skill. Those who failed to qualify for assignment to the skill because of low ASVAB scores or failure in the training course were not available for testing. In subsequent analyses, we present two sets of correlation coefficients. One is for the samples of selected examinees, called "uncorrected correlation," and the second is the estimated correlation for the full population of potential recruits, called "corrected correlation." The corrected values tend to be larger because they apply to the full range of potential scores. For purposes of setting enlistment standards and aptitude composite prerequisites for assignment to skill training courses, the corrected values are the appropriate ones to use. Although we report both sets of correlations, our main interpretations will be of the corrected values.

EFFECTS OF TEST ADMINISTRATORS ON HANDS-ON TEST SCORES

For the Ground Radio Repair and Mechanical Maintenance skills, the same test administrator gave all parts of the hands-on test to any one

TABLE 6

INTERCORRELATION OF WRITTEN TEST--INFANTRY RIFLEMAN[a]

Part	Part of written test 1	2	3	4	5	6	7	8	9	Mean score	Standard deviation
1 Infantry	-	.22	.37	.03	.19	.26	.31	.20	.18	4.5	1.4
2 Rifleman	.22	-	.24	.03	.17	.15	.16	.16	.16	2.8	0.8
3 Weapons	.37	.24	-	.13	.31	.29	.34	.34	.29	12.1	3.1
4 Prisoners-1	.03	.03	.13	-	.00	.00	-.01	.11	.07	2.2	1.8
5 Prisoners-2	.19	.17	.31	.00	-	.25	.26	.27	.19	11.9	3.4
6 Acronyms	.26	.15	.29	.00	.25	-	.46	.23	.07	8.7	2.9
7 Definitions	.31	.16	.34	-.01	.26	.46	-	.30	.18	3.2	1.4
8 NBC defense	.20	.16	.34	.11	.27	.23	.30	-	.22	7.4	2.9
9 Surveillance	.18	.16	.29	.07	.19	.07	.18	.22	-	3.3	1.1
Total	.50	.35	.72	.25	.64	.61	.59	.63	.39	56.2	10.7

[a]Number of cases is 384.

examinee. Therefore, different scoring standards used by test administrators systematically raised or lowered the hands-on scores for all examinees tested by the same administrator. To determine the effects of test administrators on hands-on scores, we grouped the examinees for each test administrator and computed test score means and standard deviations. If the examinees were assigned randomly to administrators, then the test scores should differ only by chance. In table 7, we show the hands-on test scores for the examinees tested by the same administrator. For comparison we also show the written test scores and relevant aptitude composite scores.

The hands-on test scores for both skills show a large variation among administrators. Differences between administrators are not related to differences on the written test or aptitude composite scores (Electronics Repair for Ground Radio Repair and Mechanical Maintenance for Automotive Mechanic). For the Ground Radio Repair skill, the hands-on means range from 70.0 (for administrator 6 who tested only two examinees) to 127.3 (for administrator 2 who tested 13 examinees). For the Automotive Mechanic skill, the hands-on means range from 67.8 (for administrator 2 who tested 64 examinees) to 75.1 (for administrator 1 who tested 74 examinees before 19 September 1981). After 19 September 1981, the mean score for administrator 1 dropped to 71.8. The reason for the drop is that prior to 19 September 1981 the administrators provided many clues to examinees about correct answers. After 19 September they were instructed to refrain from providing as much help. Test administrator 2 did most of his testing after 19 September (hands-on mean of 67.8), whereas administrator 4 did all of his before (hands-on mean of 73.9). Administrator 3 tested half before and half after, but was relatively lenient in both periods.

The hands-on scores were put on the same score scale by standardizing the scores for each administrator to have a mean of 50 and a standard deviation of 10. We used the conventional formula:

$$\text{Standard score} = 50 + \frac{10(X_i - \overline{X}_i)}{S_{xi}} ,$$

where:

X_i = hands-on test score, for each examinee tested by administrator i

$\overline{X}_i$ = the mean of hands-on scores assigned by administrator i

S_{xi} = the standard deviation of hands-on scores assigned by administrator i.

The standard scores remove differences among administrators in the mean and standard deviation of the scores assigned to the examinees they tested. However, standard scores do not change the shape of the distribution. For example, if an administrator tends to assign many

TABLE 7

TEST SCORES SHOWN BY TEST ADMINISTRATOR

Ground Radio Repair Skill

Variable	Administrator						
	1	2	3	4	5	6	Unknown[a]
Hands-on test							
Mean	120.1	127.3	115.5	117.5	107.0	70.0	100.6
Standard deviation	24.6	15.1	22.8	21.0	25.5	14.1	27.0
Written test							
Mean	58	52	51	55	57	56	57
ASVAB Electronics Repair aptitude mean	117	115	117	120	120	120	119
Number of examinees	16	13	20	19	20	2	44

Automotive Mechanic Skill

Variable	Administrator				
	1A[b]	1B[c]	2	3	4
Hands-on test					
Mean	75.1	71.8	67.8	74.1	73.9
Standard deviation	5.0	5.7	6.5	5.9	6.5
Testing time	142	136	131	158	129
Written test	35	34	32	38	33
ASVAB Mechanical Maintenance aptitude mean	99	106	102	103	102
Number of examinees	74	58	64	23	42

[a]Test administators did not sign the score sheets for the first 44 examinees.
[b]Examinees tested before 19 September 1981.
[c]Examinees tested after 19 September 1981.

scores close to the maximum possible score, the standard scores will also be piled up at the high end. Also, the standard scores do not change the correlation between hands-on scores and any other variable. Standard scores are linear conversions of raw scores to remove leniency or strictness effects. If the hands-on scores have other defects, they are retained.

The hands-on test scores for the Radio Repair skill do have a measurement defect that is retained in the standard scores. The maximum possible hands-on score is 140. The mean scores for administrators 1 through 4 range from 115.5 to 127.3, with standard deviations from 15.1 to 24.6. Of the 154 examinees, 14 had perfect scores of 140, and 30 scored 135 or better. The large number of high scores suggests either that the test was too easy or that the scores do not reflect the true competence level of the examinees. The relatively low mean for the first 44 examinees (100.6) tested before the administrators signed the score sheet indicates that the administrators became more lenient after they started signing their names. The number of high scores raises questions about the measurement accuracy of the hands-on scores. In subsequent analyses, we will examine the hands-on scores further to see how satisfactorily they function as measures of performance.

The hands-on scores for the Automotive Mechanic skill also were piled up at the high end. The maximum score is 81, and over 20 percent of the examinees had scores of 79, 80, or 81. For administrator 1 we standardized the scores separately for examinees tested before or after 19 September 1981. For each of the other three administrators, we computed a single set of standard scores, disregarding the time of testing. For the Automotive Mechanic skill we also show the mean hands-on testing time each administrator allowed the examinees. The maximum time was 210 minutes, and no administrator consistently approached this limit.

For the Infantry Rifleman sample, the hands-on test scores were used as assigned by test administrators, with no conversion to standard scores. The distribution of hands-on scores is satisfactory. The maximum possible hands-on score is 332, and the mean for 384 examinees is 138.7, with a standard deviation of 37.6. From a measurement point of view, the hands-on scores for the Infantry Rifleman sample do not have any obvious defects.

INTERCORRELATION OF PERFORMANCE MEASURES

After standardizing the hands-on scores, we examined their interrelationship and their correlation with other variables: final course grades in skill training courses, enlisted grade, and job experience. The analysis included the hands-on scores assigned by test administrators, called total score, and the standard scores for the Radio Repair and Mechanic samples. The standard scores should correlate more highly with the other measures than do the total scores.

The hands-on tests for the Radio Repair and Mechanic samples have both a total score, based on the number of steps scored as pass, and the time taken to complete the hands-on test. Both scores may provide useful information about level of performance. We computed an efficiency score for these two samples as the ratio of hands-on score divided by testing time. The efficiency score shows the amount of performance per unit of time. In general, higher performance is indicated by both the total score, based on the number of tasks performed, and the amount of time taken to perform the tasks. No efficiency score was computed for the Infantry Rifleman sample because the test content did not provide a meaningful measure of time to complete the test.

Ground Radio Repair

The correlation among the measures for the Radio Repair sample is shown in table 8. Part A shows the coefficients computed on the sample, and part B shows the estimated correlation in the population of potential recruits. The sample size in part A is 129 for the intercorrelation of hands-on test, written test, enlisted grade, and job experience and 59 for course grades. The standard errors of the correlation coefficients are indicated in table 8. The sample size was reduced because of incomplete data. In appendix B we present more complete data for the samples of examinees. All coefficients in part B are based on 59 cases for which complete data were available. All examinees in enlisted grade E-1 were removed because anyone in this grade had been demoted.

The intercorrelation among the measures has the expected positive pattern. The three performance measures--hands-on test, written test, and course grade--are consistent, and therefore they support the validity of each other as measures of job performance in the Ground Radio Repair skill. They have the expected positive correlation with enlisted grade and job experience. (In appendix A we describe how job experience was measured.) The corrected coefficients in part B are large and positive. The magnitude of these coefficients shows that the three performance measures are measuring something in common, and the high correlation of the hands-on test with the others supports the content validity of all measures. The evidence is strong that the measures of performance have satisfactory measurement properties.

In part A of table 8 the standard scores for the hands-on test have higher correlation coefficients with the other measures than do the other hands-on scores (total, which includes differences in scoring standards of test administrators; time to complete the test; and efficiency, or total score divided by testing time). We retained the standard scores in subsequent analysis and deleted the other hands-on scores. The hands-on score in part B and the other performance measures are on the standard score scale, with a mean of 50 and standard deviation of 10.

TABLE 8

CORRELATION OF PERFORMANCE MEASURES--GROUND RADIO REPAIR

Part A: Uncorrected Correlation Coefficients

Measure	Measure 1	2	3	4	5	6	7	8	Mean score[a]	Standard deviation[a]
Hands-on test[b]										
Total (1)	–	.90	-.57	.81	.07	.14	.18	–[c]	112.0	25.7
Standard (2)	.90	–	-.51	.73	.14	.27	.23	.25	50.0	9.7
Time (3)	-.57	-.51	–	-.92	-.05	.00	-.16	–[c]	183.7	33.6
Efficiency (4)	.81	.73	-.92	–	.08	.06	.20	–[c]	0.65	0.26
Written test (5)[b]	.07	.14	-.05	.08	–	.34	.35	.31	56.1	11.6
Enlisted grade[b] (6)	.14	.27	.00	.06	.34	–	.44	–[c]	3.8	0.8
Job experience[b] (7)	.18	.23	-.16	.20	.35	.44	–	–[c]	29.6	24.8
Course grade[d] (8)	–[c]	.25	–[c]	–[c]	.31	–[c]	–[c]	–	49.0	10.2

Part B: Corrected Coefficients, Population Estimates[e]

Measure	Measure 1	2	3	Mean score[f]	Standard[f] deviation	
Hands-on test (1)	–	.51	.52	50.8	9.3[g]	14.6[h]
Written test (2)	.51	–	.64	48.8	10.0[g]	13.8[h]
Course grades (3)	.52	.64	–	49.0	10.2[g]	14.7[h]

[a]Reported in raw scores.
[b]Number of cases is 129; probability is .95 that coefficients of .17 are greater than zero.
[c]Correlation not computed.
[d]Number of cases is 59; probability is .95 that coefficients of .27 are greater than zero.
[e]Number of cases is 59.
[f]Reported in standard scores.
[g]Observed value in sample of 59 cases.
[h]Population estimate.

The correlations of interest for course grades are with the hands-on and written proficiency test scores. Both the uncorrected and corrected coefficients are satisfactory. These results support the traditional use of grades in skill training courses as the criterion measure for validating ASVAB and for establishing enlistment qualification scores.

The magnitude of the corrected coefficients is considerably higher than that of the uncorrected ones. The reason is that the minimum qualifying aptitude composite scores for the Ground Radio Repair Skill was 110, which eliminates the bottom two-thirds of the population. The mean Electronics Repair (EL) aptitude composite score for the sample was about 118, which corresponds to a percentile score of about 80. The standard deviation of the performance measures (part B) increased by about 40 to 50 percent in the population compared to the sample. These large increases reflect the severe selection of recruits who are eligible to become radio repairers in the Marine Corps. With such severe selection, the corrected values may be in error; the bias, however, is that the corrected values tend to be underestimates of the true population values. As we shall see in the following subsections, these results are consistent with those for the Automotive Mechanic and Infantry Rifleman skills, which increases our confidence that the corrected values are reasonably accurate.

Automotive Mechanic

The performance measures for the Automotive Mechanic sample are consistent measures of job performance (table 9). The sample size is 131 cases for all correlation coefficients. The uncorrected correlation coefficients (part A, table 9) have the desired pattern of positive values, except for amount of time to complete the hands-on test, which should be negatively correlated with the other measures. The magnitude of the estimated population coefficient (part B) is adequate to support the content validity of the performance measures (hands-on test, written test, and course grade). Taken together with the Radio Repair skill, the results indicate that job performance in technical skills can be measured reliably.

The hands-on test conveys the most meaning when the efficiency scores are used. In this sample, we computed efficiency as the ratio of standard scores over time. The hands-on scores in part B, and in subsequent analyses, are the efficiency scores. The standard scores, according to the correlation coefficients, are more accurate measures than the total hands-on scores, which include differences among test administrators. By also including time in the hands-on score, the correlation with other measures is further increased. For example, the uncorrected correlation coefficient between the efficiency score and the written test is .35, compared to .26 between the standard score and written test. The other three scores for the hands-on test (total,

TABLE 9

CORRELATION OF PERFORMANCE MEASURES--AUTOMOTIVE MECHANIC[a]

Part A: Uncorrected Correlation Coefficients

Measure	Measure 1	2	3	4	5	6	7	8	Mean score[b]	Standard deviation[b]
Hands-on test										
Total (1)	-	.89	-.11	.64	.27	.25	.21	.27	72.3	6.4
Standard (2)	.89	-	-.25	.78	.26	.24	.27	.33	49.9	9.6
Time (3)	-.11	-.25	-	-.76	-.27	-.05	-.26	-.34	138.3	25.1
Efficiency (4)	.64	.78	-.76	-	.35	.20	.32	.41	49.6	10.0
Written test (5)	.27	.26	-.27	.35	-	.26	.42	.55	50.2	9.9
Enlisted grade (6)	.25	.24	-.05	.20	.26	-	.22	.32	3.1	0.6
Job experience (7)	.21	.27	-.26	.32	.42	.22	-	.37	27.3	22.8
Course grade (8)	.27	.33	-.34	.41	.55	.32	.37	-	50.7	10.0

Part B: Corrected Coefficients, Population Estimates[a]

Measure	Measure 1	2	3	Standard deviation[c] Sample	Population
Hands-on test (1)	-	.45	.51	9.6	10.6
Written test (2)	.45	-	.69	9.9	11.3
Course grade (3)	.51	.69	-	10.0	12.7

[a]Number of cases is 131; probability is .95 that coefficients of .17 are greater than zero.
[b]Reported in raw scores, except for course grades which are standardized scores.
[c]Reported in standard scores.

standard, and time) help support the meaning of the hands-on test scores, but they are not as useful as the efficiency score.

Training course grades had satisfactory correlation with the other measures, and they were retained as a performance measure. As for the Radio Repair skill, we found the three measures (part B) to be meaningful and useful for evaluating job performance.

Infantry Rifleman

Analysis of the Infantry Rifleman skill was complicated because about half of the examinees had taken ASVAB 5/6/7 at time of enlistment and the remainder had taken ASVAB 8/9/10. The former group had been in the Marine Corps longer than the latter group (mean months of service was 16.8 versus 8.9). To compute the intercorrelation of the performance measures, we combined the two groups and obtained 241 cases. An exception is for course grades, for which we used only 53 cases with ASVAB 8/9/10 scores. The uncorrected coefficients are shown in table 10, part A. The corrected values (part B) are based on the subtests common to ASVAB 5/6/7 and ASVAB 8/9/10. Details are presented in appendix B.

The intercorrelation of the three performance measures (hands-on test, written test, and course grades) have the desired pattern of positive values (part B of table 10). The magnitude of the corrected coefficients is smaller than for the two technical skills. The lower values could be a function of the job requirements or of test content. The results suggest that the latter explanation is more plausible.

Job experience, measured as months in the Marine Corps, has a negative correlation with the proficiency tests; enlisted grade is essentially uncorrelated with the performance measures. These results are counter to our expectations. An explanation is that some of the content of the proficiency tests may reflect content of the training course that is not used often on the job; perhaps many examinees tended to forget some of the content specific to the training course by the time they took the test. We also computed the correlation between time in the Marine Corps and the proficiency tests for the group of 53 that was tested with ASVAB 8/9/10. The correlation coefficients of time in service with the hands-on test, written test, and course grade were -.29, +.05, and -.29, respectively. In addition, there is a slight tendency for the more recent accessions to have higher ASVAB scores, which also helps explain the negative correlation coefficients.

Course grades correlate quite well with the performance measures. This suggests that similar types of content are included in both the tests in the training course and in the proficiency tests. Course grades in the Infantry Training School were heavily determined by paper-and-pencil, multiple choice achievement tests. The students were required to recall what they learned during the course. The content of

TABLE 10

CORRELATION OF PERFORMANCE MEASURES--INFANTRY RIFLEMAN

Part A: Uncorrected Correlation Coefficients

Measure	Measure 1[a]	2[a]	3[a]	4[a]	5[b]	Mean score	Standard deviation
Proficiency test							
Hands-on (1)	-	.46	.00	-.09	.34	50.4	10.2
Written (2)	.46	-	.00	-.16	.54	51.0	9.2
Enlisted grade (3)	.00	.00	-	.38	-[c]	2.1	0.8
Job experience (4)	-.09	-.16	.38	-	-[c]	13.0	9.2
Course grade[b] (5)	.34	.54	-[c]	-[c]	-	52.4	9.4

Part B: Corrected Coefficients, Population Estimates

Measure	Measure 1	2	3	Standard deviation: Sample	Population
Hands-on test[d] (1)	-	.56	.39	10.2	10.9
Written test[d] (2)	.56	-	.61	9.2	10.9
Course grade[b] (3)	.39	.61	-	9.4	10.2

[a]Number of cases is 241; probability is .95 that coefficient of .13 is greater than zero.
[b]Number of cases is 53.
[c]Not computed.
[d]Number of cases is 241.

the hands-on and written proficiency tests also involves memory of facts and rules taught during the training course, such as memory of acronyms and hand signals. See appendix A for a more detailed description of the test content. Apparently some of the proficiency test content was not adequately reinforced during their training in the field after graduation from the course, and some of the examinees forgot much of it.

The performance measures in each of the three skills are measuring something in common. The consistently high correlation of the hands-on test with the other measures supports the content validity of all measures. The results increase our confidence that the measures are in fact evaluating job performance. We now turn to the validity of ASVAB aptitude composites to provide further evidence to support the content validity of the performance measures.

VALIDITY OF ASVAB APTITUDE COMPOSITES

ASVAB aptitude composites traditionally have been developed using grades in skill training courses as the criteria. An exception has been the Combat (CO) aptitude composite the Army and Marine Corps use to assign recruits to combat arms skills (such as infantry, armor). For these skills, ratings of performance in combat during the Korean and Vietnam conflicts have been used as the primary criteria. The definitions of most aptitude composites, in terms of subtests in each, have remained relatively stable since the classification batteries were introduced in the late 1940s. The Clerical (CL) or Administrative composite has included tests of verbal skills and of perceptual speed and accuracy. The Mechanical Maintenance (MM) composite has included automotive information; Electronics Repair (EL), electrical or electronics information; and General Technical (GT), verbal and quantitative skills. The definitions of the aptitude composites have been reasonable to experienced personnel managers, and they were derived from empirical data.

Because of their longstanding use and acceptance by DoD personnel managers, aptitude composites can help establish the credibility of the performance measures. For the Ground Radio Repair skill, the EL aptitude composite should have a higher predictive validity than either GT, which tends to measure academic skills, or CL, which is appropriate for office jobs. For the Automotive Mechanic skill, the MM composite should have a higher validity than GT or CL.

For the Infantry Rifleman skill, our a priori expectations are not as clear. The job requirements for riflemen in combat are difficult to define, and then to capture the requirements in a paper-and-pencil test battery is even more difficult. The types of items found most predictive of combat performance during the Korean conflict were self-descriptions. These items were incorporated into the Classification Inventory that was part of the Army Classification Battery and ASVAB since 1958. Items in the Classification Inventory were updated during the Vietnam conflict.

The Classification Inventory was dropped from ASVAB 8/9/10 in 1980, and the CO composite no longer contains self-description items. For the Infantry Rifleman skill, we may gain some insight into the job requirements by the predictive validity of different aptitude composites.

Ground Radio Repair

For the Ground Radio Repair skill, the EL aptitude composite has the highest validity for predicting the written test and course grade, but not for predicting the hands-on test (table 11). The uncorrected correlation coefficients cannot be compared directly because of the severe selection of the examinees on the basis of their EL scores. The corrected validity coefficients have been made comparable by estimating the values in an unselected population. The pattern of uncorrected and corrected validity coefficients is the same; a consistent result is that EL has a lower predictive validity against the hands-on test than does either the GT or CL composite.

TABLE 11

VALIDITY OF ASVAB APTITUDE COMPOSITES--
GROUND RADIO REPAIR[a]

Performance measure	ASVAB aptitude composite: Uncorrected			Corrected		
	EL[b]	GT[c]	CL[d]	EL	GT	CL
Hands-on test	.21	.36	.32	.59	.68	.62
Written test	.34	.33	.25	.73	.69	.61
Course grade	.43	.30	.23	.75	.62	.57

[a]Number of cases is 59.
[b]Electronics Repair.
[c]General Technical.
[d]Clerical.

The pattern of corrected coefficients supports the content validity of the other two performance measures (written test and course grades). The content validity of the hands-on test does not need empirical support. The relatively high validity of the GT composite, which is largely a measure of academic aptitude, suggests that the hands-on test contains a component of general mental ability, as well as skills and knowledge specific to electronics repair. The hands-on test required the examinees to apply their skills and knowledge in a novel situation

by troubleshooting a new piece of equipment. The relatively high validity of the aptitude composites against the hands-on test counters the argument advanced by some people that although the ASVAB can predict success in training courses, it cannot predict hands-on performance of job tasks.

The magnitude of the corrected EL validity coefficients (from .59 to .75) shows that EL is able to predict performance in the Ground Radio Repair skill. Even though the pattern does not conform to prior expectations, the absolute values are satisfactory.

Automotive Mechanic

Of the three aptitude composites shown in table 12, MM has the highest predictive validity against all three performance measures. Course grades are especially predictable by MM. The corrected validity coefficient is .83, and even the uncorrected value is .73. The pattern of validity conforms to our a priori expectations, and the content validity of the measures is supported.

The hands-on test for the Automotive Mechanic skill required examinees to perform tasks on which they had been trained and on which they should have had numerous opportunities to perform as part of their normal job duties (working on the quarter-ton Jeep).

The magnitude of the corrected validity coefficients indicates that the ASVAB is a good predictor of performance in the Automotive Mechanic skill. Recruits can be assigned as mechanics on the basis of their MM scores, and their job performance will be reasonably consistent with their aptitude scores.

TABLE 12

VALIDITY OF ASVAB APTITUDE COMPOSITES--
AUTOMOTIVE MECHANIC[a]

Performance measure	ASVAB aptitude composite: Uncorrected MM[b]	GT[c]	CL[d]	Corrected MM	GT	CL
Hands-on test	.49	.23	.23	.56	.39	.39
Written test	.49	.32	.23	.65	.55	.48
Course grade	.73	.58	.46	.83	.75	.66

[a]Number of cases is 131.
[b]Mechanical Maintenance.
[c]General Technical.
[d]Clerical.

Infantry Rifleman

The validity of the aptitude composites for the Infantry Rifleman skill are shown in table 13. In part A, the results are shown for examinees tested with ASVAB 8/9/10, and in part B, for those tested with ASVAB 5/6/7. The pattern of validity coefficients does not conform to our prior expectations. GT is the most valid predictor of all performance measures, except for the hands-on test in the group tested with ASVAB 8/9/10. In this group, CO has a corrected validity of .58 compared to .53 for GT. The proficiency tests are more predictable than course grades. The difference in size of validity coefficients suggests that course grades may be measuring things somewhat different from the hands-on and written tests. Because the proficiency tests were developed by job experts explicitly to measure job requirements, we can be more confident of their content validity than of the course grades.

But there are enough results that raise questions about the meaning of the proficiency test scores for the Rifleman skill. The ASVAB subtests with the highest predictive validity against the proficiency tests measure verbal ability (the validity of the ASVAB subtests is presented in appendix B). Although verbal ability is important for riflemen, it does not ordinarily come to mind as a prime requirement for success in the skill. From the results on the consistency of performance measures for the Infantry Rifleman skill, we are left with some doubt about the content validity of any of the measures. The magnitude of the corrected validity coefficients (ranging from .5 to .6) indicates that the ASVAB is a reasonably valid predictor of success in the Infantry Rifleman skill, as success is measured in peacetime. The results suggest that the ASVAB can continue to be used for assigning recruits to the Infantry Rifleman skill with reasonable assurance that the aptitude scores are related to performance as measured by these tests.

PREDICTABILITY OF COMPOSITE PERFORMANCE MEASURES

The previous analyses in this chapter have shown that the performance measures are reasonably consistent and that the relevant ASVAB aptitude composites generally are accurate predictors of the measures. With the performance measures, we determine how well people perform on the job. Through the pattern of ASVAB validity coefficients, we know the types of people that have the aptitude to do well in each skill. People with relatively high aptitude in Electronics Repair can be assigned to radio repair; those high in Mechanical Maintenance, to automotive mechanics; and those in Combat, to riflemen. The next question to be addressed is whether combining the performance measures would change the size of the validity coefficients enough to affect the minimum qualifying scores for assignment to the skills.

TABLE 13

VALIDITY OF ASVAB APTITUDE COMPOSITES INFANTRY RIFLEMAN

Part A: Examinees Tested with ASVAB 8/9/10[a]

Performance measure	ASVAB aptitude composite					
	Uncorrected			Corrected		
	CO[b]	GT[c]	CL[d]	CO	GT	CL
Hands-on test	.40	.37	.20	.58	.53	.41
Written test	.48	.55	.31	.69	.77	.51
Course grade	.13	.21	-.04	.29	.41	.08

Part B: Examinees Tested with ASVAB 5/6/7[e]

Performance measure	Uncorrected			Corrected		
	CO	GT	CL	CO	GT	CL
Hands-on test	.31	.43	.24	.53	.64	.53
Written test	.28	.58	.39	.54	.77	.65
Course grade	-[f]	-[f]	-[f]	-[f]	-[f]	-[f]

[a]Number of cases is 53.
[b]Combat.
[c]General Technical
[d]Clerical.
[e]Number of cases is 140.
[f]Not computed.

Ground Radio Repair

The predictive validity of EL is shown in table 14. The performance composites are reasonable combinations of the measures that might be used to evaluate performance. The three performance measures are labeled 1, 2, and 3, and the composites are shown as combinations of the numbers. The composites are about equally predictable by EL; the validity coefficients range from .76, for the hands-on plus written tests (1 + 2), to .82, for the proficiency tests and course grades (1 + 2 + 3 and 2 + 3). The similarity of these values means that about the same level of minimum qualifying EL score would be established against each of the composite performance measures. In other words, about the same people would be assigned to the Ground Radio Repair skill no matter which composite performance measure is used as the criterion for setting qualifying standards.

TABLE 14

VALIDITY OF ELECTRONICS REPAIR APTITUDE
COMPOSITE--GROUND RADIO REPAIR

Performance measure	Validity of Electronics Repair (EL) aptitude composite: Uncorrected	Corrected
1 Hands-on test	.21	.59
2 Written test	.34	.73
3 Course grade	.43	.75
Composite:		
1 + 2	.36	.76
1 + 2 + 3	.47	.82
2 + 3	.48	.82

The composites were obtained by standardizing each performance measure to have a mean of 50 and a standard deviation of 10. When combining the measures, they were weighted equally, The combination of hands-on test, written test, and course grade (1 + 2 + 3) was standardized as a measure of proficiency; this combination appears to be the best measure of the skills and knowledge required to perform the job tasks. This comprehensive measure is perhaps the best evaluation of skills and knowledge required for the job.

As we discussed in chapter 1, proficiency tests are expensive to develop and administer. If they are to be used for establishing qualification standards, they should provide information not available from more economical performance measures, such as training grades. For the Ground Radio Repair skill we found that using course grades alone produces the same answer for establishing qualification standards as would using the proficiency tests. The hands-on test is less predictable by EL, and its use would result in higher qualification standards than would use of either the written proficiency test or course grades. These results do not indicate a need in the Ground Radio Repair skill to use a performance measure different from the traditional course grades for establishing qualification standards.

Automotive Mechanic

For the Automotive Mechanic skill, course grades are much more predictable by MM than are the other performance measures (table 15). Performance composites that include course grades are more predictable than those without. Because of their lower predictability, the use of

proficiency tests for establishing minimum qualification scores could result in somewhat higher ASVAB qualification standards than use of only course grades.

TABLE 15

VALIDITY OF MECHANICAL MAINTENANCE
APTITUDE--AUTOMOTIVE MECHANIC

Performance measure	Validity of Mechanical Maintenance (MM) aptitude composite	
	Uncorrected	Corrected
1 Hands-on test	.49	.56
2 Written test	.49	.65
3 Course grade	.73	.83
Composite:		
1 + 2	.60	.71
1 + 2 + 3	.72	.82
2 + 3	.69	.81

The corrected validity coefficient for predicting course grades (.83) is somewhat higher than normally found. Grades in the Automotive Mechanic course are among the most predictable of all courses in the Marine Corps. In a recent CNA study the validity of the MM aptitude composite was .64 [3] against course grades. The .83 found in this study is higher than the .64 but not different enough to discredit the results. Course grades appear to be an adequate criterion measure in this skill for establishing qualification standards.

Infantry Rifleman

The validity of the CO aptitude composite was computed for two groups of examinees: those tested with ASVAB 5/6/7 and those tested with ASVAB 8/9/10 (table 16). For the Infantry Rifleman skill, the hands-on and written proficiency tests are more predictable than course grades. The most predictable performance composite is the sum of the hands-on and written scores (r = .72 in the group tested with ASVAB 8/9/10). Adding course grades lowered the predictive validity. The most comprehensive performance composite (1 + 2 + 3) has a correlation coefficient with CO of .64 (in the group tested with ASVAB 8/9/10). The differences in validity coefficients mean that different minimum qualification standards would be set for different performance measures. Because the proficiency tests are more predictable by CO, they would

result in lower ASVAB qualification standards than would use of course grades.

TABLE 16

VALIDITY OF COMBAT APTITUDE COMPOSITE--INFANTRY RIFLEMAN

Performance measure	Validity of Combat (CO) aptitude composite			
	Group 1[a]		Group 2[b]	
	Uncorrected	Corrected	Uncorrected	Corrected
1 Hands-on test	.31	.53	.40	.58
2 Written test	.28	.54	.48	.69
3 Course grade	–[c]	–[c]	.13	.29
Composite:				
1 + 2	.35	.59	.52	.72
1 + 2 + 3	–[c]	–[c]	.43	.64
2 + 3	–[c]	–[c]	.35	.57

[a]Examinees tested with ASVAB 5/6/7; number of cases is 140.
[b]Examinees tested with ASVAB 8/9/10; number of cases is 53.
[c]Not computed.

SUMMARY

In this chapter we examined the consistency among the three measures of performance (hands-on test, written test, and course grades). In general, we found that the intercorrelation among them indicates they tend to be measuring the same thing. Prior to using the hands-on and written test scores in any analyses, we computed the intercorrelation among the parts of each test. We found that the parts tended to be positively intercorrelated. The statistical analysis found no reasons to drop any of the measures.

We then correlated ASVAB aptitude composites with the performance measures. In general, the relevant aptitude composites had the highest predictive validity against the performance measures (EL for the Ground Radio Repair skill; MM for the Automotive Mechanic skill; and CO for the Infantry Rifleman skill). The hands-on tests for Radio Repair and Rifleman skills, however, were more predictable by GT, a measure of academic aptitude, than by EL and CO, respectively. The hands-on test scores for Radio Repair and Mechanic skills were found to be suspect

because they were piled up at the high end. The test scores for riflemen may have a large memory component.

Finally, we developed composites of the performance measures. For the two technical skills, use of the hands-on and written proficiency tests as criterion measures would give the same results as course grades. For the Infantry Rifleman skill, however, the proficiency tests were more predictable than course grades.

The analyses in this chapter did not attempt to establish minimum qualifying scores. All they were intended to do was establish the credibility of the measures for evaluating job performance. In the next chapter, we use the performance measures to compute minimum qualifying scores.

CHAPTER 3

ESTABLISHMENT OF ASVAB QUALIFICATION STANDARDS FROM THE PERFORMANCE MEASURES

INTRODUCTION

The relationship between selection and classification test batteries, such as the ASVAB, and measures of performance has long been used in the personnel testing tradition for setting qualification standards. In this chapter we outline the model that has guided use of selection and classification tests in military personnel decisions. We then compute a set of qualifying standards on the ASVAB using the available data in this study, supplemented with assumptions about the meaning of the performance measure scores. We close the chapter by presenting the percentage of satisfactory performers in ASVAB score intervals. The results presented in this chapter do not consider costs of recruiting applicants when setting qualification standards, or the cost of rejecting people who fail to meet the qualification standards but who would, if accepted, perform satisfactorily on the criterion measure. A more thorough cost-effectiveness analysis of qualification standards is the subject of a follow-on research effort.

The model that has guided use of selection and classification tests by the military services may be characterized as follows. The ASVAB is used to provide information to personnel decision makers about how well potential recruits are expected to perform in the variety of military jobs. Because most applicants for enlistment have limited job experience, and the military services have such a broad range of skills open to recruits, personnel decision makers need an accurate and efficient way to predict how well applicants can perform across the range of military skills. The ASVAB is generally accepted by personnel managers as an adequate predictor of performance in the military. Based on ASVAB scores and other information, applicants are judged to be qualified for service or not. If their predicted performance is in the satisfactory range, then they are said to be qualified. If their predicted performance is unsatisfactory, then the applicants are judged to be unqualified for enlistment.

The model requires three essential pieces of information. First, the ASVAB must be a valid predictor of performance in the military. If the ASVAB is a poor predictor, then selection and classification decisions based on ASVAB scores are close to random, and the predicted performance of those who qualify on the ASVAB differs little from that of those who are unqualified. Only to the extent that the ASVAB is an accurate predictor do qualifying standards result in improving the performance of people accepted for service. Fortunately the results in chapter 2 support the predictive validity of the ASVAB, and qualifying standards can be set with reasonable confidence.

The second piece of information relates to the difference between satisfactory and unsatisfactory levels of performance. Somehow a score must be set on the performance measure that demarcates satisfactory and unsatisfactory performance. The score can be set directly on the performance measure itself, such as specifying the number of items or tasks that must be passed; or, the satisfactory score can be set indirectly by specifying the percentage of the population that would perform satisfactorily and then setting the minimum satisfactory score on the performance measure accordingly.

The third piece of information concerns an acceptable rate of unsatisfactory performance among those who meet the qualifying standards on ASVAB. Because the ASVAB, as any selection and classification test, does not predict performance perfectly, some people who qualify on the ASVAB will subsequently have unsatisfactory performance scores. The services perforce must live with recruits who are unsatisfactory. A traditional practice in the military is to decide on an acceptable failure rate in skill training courses.

With these three pieces of information--validity of the ASVAB, satisfactory score on the performance measure, and acceptable failure rate--ASVAB qualifying scores can be set. In the next subsection, we compute a set of qualifying scores on the ASVAB.

COMPUTING QUALIFYING APTITUDE COMPOSITE SCORES

Satisfactory Score on the Performance Measures

In this study we made an assumption about the percentage of the population that would be satisfactory performers in each skill. As a rule, this type of assumption is more plausible than attempting to set the satisfactory score directly on the performance measure itself. The former assumption requires only that we know something about the difficulty of the skill compared to other jobs. The assumption about setting a cutting score on the performance measure requires that we know how the content of the performance measure is related to the full set of job requirements, and further that a meaningful and unambiguous demarcation can be made between satisfactory and unsatisfactory scores on the performance measure. Establishing an a priori satisfactory score on the performance measure, called "criterion-referenced standards" in testing jargon, implies an absolute level of performance that is unaffected by testing conditions or by the difficulty of the test. Because our performance measures are experimental, we would be especially reluctant to establish a priori satisfactory scores on them.

The percentages of satisfactory performers for the Radio Repair and Mechanic skills were obtained from data for the World War II (WWII) era. The Army General Classification Test (AGCT) scores were computed for soldiers grouped by their former civilian occupation [4]. AGCT score distributions were computed for people who were radio repairers and

automobile mechanics. The mean AGCT score for radio repairers was 117, which is about one standard deviation above the population mean of 100. We assumed that the bulk of radio repairers were satisfactory, but that the bottom of the distribution was unsatisfactory. We selected the point one standard deviation below the mean performance of all radio repairers as the cutting score to demarcate satisfactory and unsatisfactory performance; this point is about the population mean of the AGCT scores. Thus, we assume that half the population could be satisfactory radio repairers.

For automobile mechanics, the mean AGCT score of WWII soldiers who were mechanics before entering the Army was 102, close to the population mean. The AGCT score one standard deviation below the mean of the automobile mechanic sample was about 85, which corresponds to a percentile score of about 25. We assumed that 70 percent of the population could be satisfactory automotive mechanics.

No comparable data are available for riflemen. We assumed that 80 percent of the population would be satisfactory riflemen. Based on the experience of the Marine Corps and Army during and since WWII, virtually all males eligible to serve can be trained to become a rifleman. The primary bar to being a satisfactory rifleman is physical ability. Some mental standards, as measured by the ASVAB, also apply. Congress has established that the bottom 10 percent of the population on ASVAB cannot be inducted during mobilization. Because even riflemen should have minimal literacy skills to cope with their job requirements, the Marine Corps and Army prefer to maintain somewhat higher standards for assignment to infantry jobs. Our assumption that 80 percent could be satisfactory riflemen applies to those who are physically able.

In summary, the assumptions we made about the percentage of the population that would be satisfactory in each skill are:

- Ground Radio Repair--50 percent of the population could be trained to be satisfactory performers, which implies that under normal circumstances 50 percent would be unsatisfactory performers.

- Automotive Mechanic--70 percent would be satisfactory, and 30 percent unsatisfactory.

- Infantry Rifleman--80 percent satisfactory and 20 percent unsatisfactory.

Acceptable Rate of Unsatisfactory Performance

A policy decision about the cost of obtaining satisfactory performers must be made by any employer who builds a work force. The military services spend large amounts of money, in the billions each

year, to recruit and train enlisted personnel. If the enlistment standards and prerequisites for assignment to skill training courses are low, recruiting costs are relatively low, but training costs are high. Conversely, if qualification standards are high, recruiting costs are high and training costs low. The establishment of qualification standards invariably involves the costs of obtaining the requisite number of satisfactory performers.

The policy decision about an acceptable rate of unsatisfactory performers we adopted for purposes of our analysis is in terms of an acceptable failure rate during skill training. We assumed that the failure rate should not exceed 10 percent. This value is a reasonable average across all Marine Corps training courses. Traditionally, the failure rate in the Basic Electronics Course, a prerequisite course for training in radio repair, has exceeded 10 percent. In FY 1980 the failure rate was 25 percent: this number includes all reasons, both academic and nonacademic, such as physical disability. The failure rate in the Basic Automotive Mechanic course has been around 10 percent; in FY 1980, 13 percent of the input failed for all reasons. Failure rates for Infantry Rifleman traditionally have been less than 10 percent. In FY 1980, it was 5 percent, but none of the failures were for academic reasons. In FY 1980, about half the Marine Corps courses had failure rates below 10 percent, and about half were above 10 percent [3]. An acceptable failure rate of 10 percent for Marine Corps courses appears reasonable.

An additional minor assumption facilitates the computation of minimum qualifying standards for each skill. If we assume that the performance measure scores are normally distributed and that they are normally distributed in each aptitude composite score interval, then conventional statistical tables can be used in the analysis. This assumption, too, is reasonable.

Validity of the ASVAB

The validity of the ASVAB depends on the criterion measure the battery is being validated against. As we discussed in the Introduction, the benchmark performance measure is the hands-on performance test. As a first step in setting qualification standards, we need to compute standards against this measure. Hands-on performance tests by themselves, however, sample only a limited portion of the job requirements in a skill. A more comprehensive criterion measure can usually be obtained by combining the hands-on and written proficiency tests. The combination of hands-on and written tests, we believe, provides a better measure of job performance than either one alone. We used the following validity coefficients in our analysis to compute ASVAB qualification standards. The coefficients are the population estimates rounded to the nearest .05.

Skill	Validity: Hands-on	Validity: Hands-on and written
Ground Radio Repair	.60	.75
Automotive Mechanic	.55	.70
Infantry Rifleman	.60	.70

Qualifying Aptitude Composite Scores

Given these validity coefficients, and the a priori values about the percent of the population that would be satisfactory performers and the acceptable failure rate, the qualifying aptitude composite scores can be determined by table lookup. A set of tables, called the Taylor-Russell tables [5], shows the expected failure rates for combinations of the values. In table 17, we present values taken from the Taylor-Russell tables that are relevant to this study.

The values in table 17 assume a normal bivariate distribution between aptitude composites and performance measures. We used the 1980 score scale for the aptitude composite because the 1980 scale more accurately reflects the current population of potential recruits.

Part A of table 17 should be used for determining the qualifying aptitude composite score for the Ground Radio Skill (50 percent of the population is satisfactory). With a validity coefficient of .75 for the hands-on plus written test, the expected failure for an EL score of 115 (about 25 percent of the population would be qualified on EL) is 11 percent; for an EL score of 120 (about 15 percent qualified on EL) the expected failure rate is 6 percent. With a validity coefficient of .60 for the hands-on test by itself, at an EL score of 120 the expected failure rate is 13 percent, which is well above our assumed acceptable rate of 10 percent. Use of the hands-on test as the criterion measure would result in a higher qualification standard than the combined hands-on plus written test. For radio repairers, the relationship among validity, EL qualification score, and percent failures is summarized as follows:

Validity	EL score	Percent failures
.75	115	11
.75	120	6
.60	120	13

A reasonable qualifying standard for assigning recruits to the Ground Radio Repair skill, using the combined hands-on plus written proficiency as the criterion, is 115.

TABLE 17

EXPECTED FAILURE RATES[a] FOR QUALIFYING
APTITUDE COMPOSITE SCORES

Part A: Percent of Population Satisfactory Performers = 50

(Ground Radio Repair)

Aptitude[b] composite score	Percent[c] qualified	Validity coefficient						
		.50	.55	.60	.65	.70	.75	.80
80	85	.45[d]	.44	.43	.43	.42	.42	.42
85	75	.42	.41	.40	.38	.37	.36	.36
90	70	.40	.39	.38	.36	.35	.34	.33
95	60	.37	.35	.34	.32	.30	.28	.27
100	50	.33	.31	.30	.27	.25	.23	.20
105	40	.30	.28	.25	.23	.20	.18	.15
110	30	.26	.24	.21	.18	.15	.13	.10
115	25	.24	.22	.19	.16	.13	.11	.08
120	15	.19	.16	.13	.11	.08	.06	.03

Part B: Percent of Population Satisfactory Performers = 70

(Automotive Mechanic)

Aptitude[b] composite score	Percent[c] qualified	.50	.55	.60	.65	.70	.75	.80
80	85	.25	.24	.23	.22	.22	.21	.20
85	75	.22	.21	.20	.19	.18	.17	.16
90	70	.20	.19	.18	.17	.16	.14	.13
95	60	.18	.17	.15	.14	.12	.11	.09
100	50	.16	.14	.13	.11	.09	.08	.06
105	40	.13	.12	.10	.08	.07	.05	.03
110	30	.11	.09	.08	.06	.04	.03	.02
115	25	.10	.08	.07	.05	.04	.03	.02
120	15	.07	.05	.04	.03	.02	.01	.01

[a]Derived from Taylor-Russell tables [5].
[b]1980 score scale.
[c]Assume normal distribution of aptitude composite scores; rounded to nearest 5.
[d]Failure rate shown in cells of table.

TABLE 17 (Cont'd)

Part C: Percent of Population Satisfactory Performers = 80

(Infantry Rifleman)

Aptitude[b] composite score	Percent[c] qualified	Validity coefficient .50	.55	.60	.65	.70	.75	.80
80	85	.15	.15	.14	.13	.12	.12	.11
85	75	.13	.12	.11	.10	.09	.09	.08
90	70	.12	.11	.10	.09	.08	.07	.06
95	60	.10	.09	.08	.07	.06	.05	.04
100	50	.09	.08	.06	.05	.04	.03	.02
105	40	.07	.06	.05	.04	.03	.02	.01
110	30	.06	.05	.04	.03	.02	.01	.00
115	25	.05	.04	.03	.03	.02	.01	.00
120	15	.04	.03	.02	.01	.01	.00	.00

For the Automotive Mechanic skill, part B of table 17 should be used (percent of satisfactory performers is 70). With a validity coefficient of .70, for the hands-on plus written tests, the expected failure rate is 12 percent at an MM score of 95 (about 60 percent of the population would be qualified on MM) and 9 percent at an MM score of 100 (50 percent qualified on MM). With a validity coefficient of .55, for the hands-on test by itself, the expected failure rate of 12 and 9 percent occur at MM scores of 105 and 110, respectively. For automotive mechanics, the relationship among validity, qualification score, and percent failures is summarized as follows:

Validity	MM score	Percent failures
.70	95	12
.70	100	9
.55	105	12
.55	110	9

A reasonable qualifying standard for the automotive mechanic skills, using the hands-on plus written tests as the criterion measure, is an MM score of 95.

For the Infantry Rifleman skill, we assumed that 80 percent of the population would be satisfactory performers (part C of table 17). With a validity coefficient of .70, for the hands-on plus written tests, the expected failure rate is .12 when the qualifying CO score is 80 (about 80 percent of the population would be qualified on CO) and .09 when the

qualifying CO score is 85 (about 75 percent qualified on CO). With a validity coefficient of .60 for the hands-on test by itself, the expected failure rate is 10 percent at a CO score of 90. For infantrymen, the relationship among validity, CO qualification score, and percent failures may be summarized as follows:

Validity	CO score	Percent failures
.70	80	12
.70	85	9
.60	90	10

A reasonable qualifying standard for assignment to the Infantry Rifleman skill, using the hands-on plus written tests as the criterion measure, is a CO score of 85.

The qualifying standards based on the combination of hands-on plus written proficiency tests, for the three skills agree closely with the current Marine Corps standards. The two sets of standards were derived independently, and their correspondence supports their reasonableness. The current standards are based on the validation data collected in 1978 and 1979. Failure rates during FY 1980 for the skill training courses were used to help set the current Marine Corps qualifying aptitude composite scores [3].

The current qualifying EL score for assignment to the Ground Radio Repair skill is 115, which agrees exactly with our preferred value. The current qualifying MM score for assignment to the Automotive Mechanic skill is 90 for high school graduates and 100 for non-high school graduates. Our MM value is 95, the average of the current values. The current qualifying CO score for the Infantry Rifleman skill is 80 for high school graduates and 90 for nongraduates. Again, our CO score of 85 is the average of the current standards. The correspondence between the two sets of standards does not, of course, prove that they are right; it only enhances their plausibility.

Comparison of parts A, B, and C in table 17 shows that the expected failure rates are sensitive to the assumed percentage of the population that is satisfactory performers. For difficult skills, with only 50 percent of the population satisfactory, the failure rate is substantially higher, other things equal, than for easier skills, with 70 or 80 percent of the population satisfactory. The failure rate also increases as a larger percentage of the population has qualifying aptitude composite scores, or as the qualifying aptitude composite score is lowered. For example, with a validity coefficient of .75 for the Ground Radio Repair course (for which 50 percent of the population would be satisfactory performers) and a qualifying EL score of 90, the expected failure rate is .34; the failure rate is only .11 with a qualifying EL score of 115. The effect of increased validity on the failure rate is

much smaller. As a rule, increasing the validity by .05 lowers the failure rate by a maximum of 3 percentage points (table 17), other things equal. Training schools have long known that the best way to reduce failure rates is to raise entrance standards. In fact, traditionally training schools have argued for higher standards to reduce their failure rates.

The Taylor-Russell tables can be used to determine the effects of various qualifying standards on failure rates. If the difficulty of a skill is assumed to have a different value, then the expected failure rate for a given qualifying aptitude composite score will also change.

Some Issues in Setting Qualifying Standards

The setting of qualifying standards is a complex process that requires input from several disciplines, but in the final analysis it is a matter of expert judgment. The fundamental requirement is that the selection and classification tests and other selection standards have predictive validity. In so far as feasible, the desired outcome is that people who meet the qualifying standards become satisfactory performers (called "true positives") while those who fail to qualify would be unsatisfactory performers (called "true negatives"). This outcome is a direct function of the validity of the instruments used to set qualifying standards--the higher the validity, the more accurate the predictions.

No qualifying standards are perfectly valid, and the cost of misclassifying people is an important issue in setting standards. One cost that was considered explicitly in our analyses is that of accepting recruits who become unsatisfactory performers. These people are sometimes called "false positives." The services traditionally have attempted to minimize this cost by controlling the failure rate in skill training courses. A cost that remains hidden is that of excluding people who fail on the qualifying standards but who would become satisfactory performers if they were enlisted. They are sometimes called "false negatives." Because the false negatives are not allowed to enlist, their potential contribution cannot be realized. The percentage of false positives and false negatives is related to the validity of the qualifying standards--the higher the validity, the smaller the percentage.

Personnel psychologists in the military traditionally have been involved in developing and validating selection and classification instruments. They traditionally have used two procedures as input to setting enlistment standards that are affected in opposite ways by the validity of the predictors. The simplest procedure is to compute the predictor score that corresponds to the minimum satisfactory performance score; minimum qualifying standards in these procedures are a direct function of the regression line relating performance and predictor. The general outcome with this procedure is that the lower the validity, the

lower the qualifying standards. If a predictor has low validity, then people with low scores perform about as well as people with high scores, and there is no justification for high standards.

The second procedure is the one we employed here, which considers the cost of accepting false positives. This procedure involves the ratio of satisfactory (true positives) and unsatisfactory (false positives) performers among those who meet the qualifying standards. Ordinarily the ratio is set by personnel managers. With this procedure, which considers some costs, the effects of validity on standards are opposite of those using the simple regression procedure. As we found when comparing the hands-on test by itself, which had lower validity, to the combination of hands-on plus written test, higher validity resulted in lower standards.

The traditional procedures either ignored costs (the regression approach) or used only rudimentary costs (failure rates). During the draft environment, when procuring people was relatively easy, recruiting costs could be largely ignored. In the all-volunteer environment, where the services must compete with civilian employers and academic institutions, procurement costs are substantial. Another complicating factor in setting standards arises from equal employment opportunities. The question of false negatives assumes greater significance for racial/ethnic minorities when setting qualifying standards. The validity of the standards is still the fundamental issue, but issues of cost and even social policy need more systematic consideration.

In addition to personnel psychologists, economists can perform an essential role by collecting cost data on recruiting people. Operations research analytical techniques to model various combinations of costs and enlistment standards are required to simulate the complex interactions. Brogden [6] has developed the theoretical solution to evaluating the classification efficiency of a test battery. The function maximized in his solution is predicted performance of people assigned to the various types of skills. The validity of the predictors and the intercorrelation of the predicted performance scores are the dominant factors that determine classification efficiency. When setting and validating qualifying standards the function to be maximized is still predicted performance. Other factors, however, such as cost, attrition, and perhaps social policy, also need to be considered when evaluating the effects and feasibility of alternative standards [7].

PERCENT SATISFACTORY IN EACH ASVAB SCORE INTERVAL

The ASVAB score scale traditionally has been divided into intervals. Even though the ASVAB score scale is continuous, personnel managers often treat persons with ASVAB scores in the same interval similarly and those in adjoining intervals differently. Of particular importance to DoD personnel managers are the AFQT categories. The AFQT score scale is divided into five intervals or categories:

- I and II, percentile scores 65 through 99--most commissioned officers and many senior noncommissioned officers score in these intervals.

- III, percentile scores 31 through 64--qualification standards on aptitude composites for assignment to skill training typically correspond to this interval; enlistment bonuses typically are restricted to recruits who have AFQT scores of 50 or above (category IIIA).

- IV, percentile scores 10 through 30--AFQT enlistment standards usually are set in this interval, especially during times of mobilization.

- V, percentile scores 1 through 9--since World War II people in this interval are unqualified to serve in the military services.

Qualifying aptitude composite scores usually have been set at 90, 100, or 110, where the population mean is 100 and standard deviation is 20. Since 1980, some qualifying aptitude composite scores have been set in intervals of 5, such as 85, 90, 95. For administrative convenience, the score intervals are used in personnel decisions rather than the smaller 1 or 2 point intervals in which the scores are computed.

In this subsection we compute the percent of satisfactory performers in 10 point intervals of aptitude composite scores and in the AFQT categories. The statistical computations are relatively complex because no convenient tables, similar to the Taylor-Russell tables, are available for computing the percentages. We describe the procedures for computing the performance score that demarcates satisfactory-unsatisfactory performance in some detail. Readers who prefer to make different assumptions about the percent of the population that would be satisfactory performers then can compute different minimum satisfactory performance scores, which would change the percentage satisfactory in each ASVAB score interval.

Computing the Performance Score that Demarcates Satisfactory-Unsatisfactory Performance

First, we need to assume the percentage of the population that is satisfactory performers. We make the same assumptions as previously:

- Ground Radio Repair skill--50 percent

- Automotive Mechanic skill--70 percent

- Infantry Rifleman skill--80 percent.

Next, we need to estimate the standard deviations of the performance measures in the population of potential recruits. The estimated standard deviations are obtained from the corrections of the validity coefficients (reported in appendix C). The estimated population standard deviations are 16.40 for the Ground Radio Repair skill (table 18), 11.33 for the Automotive Mechanic skill (table 19), and 11.69 for the Infantry Rifleman skill (table 20).

The estimated population mean of the performance measures is the predicted value that corresponds to the aptitude composite score of 100, the population mean on the ASVAB. The estimated population mean is 42 for radio repairers (table 18, part B), 50 for mechanics (table 19, part B), and 52 for rifleman (table 20, part B).

To find the performance score that demarcates satisfactory and unsatisfactory performance, compute the performance measure score that corresponds to the percent of population that is satisfactory performers. We assume that the performance measures are normally distributed in the population. For radio repairers, where 50 percent of the population is assumed to be satisfactory, the minimum satisfactory performance score is 42. In a normal distribution, the mean corresponds to a percentile score of 50, and, hence, the estimated population mean (42) is the minimum satisfactory performance score.

For mechanics, where 70 percent of the population is assumed to be satisfactory, the mimimum satisfactory performance score is 44. In a normal distribution, about 70 percent of the population lies above the point one-half standard deviation below the mean. The satisfactory-unsatisfactory point, therefore, is one-half standard deviation below the mean. The estimated population standard deviation of the performance measure is 11.33 (table 19) and one-half rounds to 6, which is subtracted from the estimated population mean of 50.

For riflemen, where 80 percent of the population is assumed satisfactory, the minimum satisfactory performance score is 42. About 80 percent of the population lies above the point .85 standard deviation below the population mean. The estimated population mean is 52 and the estimated population standard deviation is 11.69 (table 20). The minimum satisfactory performance score for riflemen, therefore, is 42 (minimum = 52 - 11.69 x .85).

Computing the Percent Satisfactory in Each Score Interval

The percent satisfactory in each ASVAB score interval is the portion that falls above the satisfactory performance score. To calculate the percentage, we need to compute the distance, in standard deviation units, between the regression line and the satisfactory score. For convenience, we use the midpoint of the interval, and we assume that the performance scores are normally distributed in each interval. In each interval, 50 percent is above the regression line at the midpoint, and

TABLE 18

REGRESSION OF PERFORMANCE ON ASVAB--GROUND RADIO REPAIR[a]

Part A: Regression Equations

Performance measure			Electronics Repair Composite				AFQT			
Variable	Sample mean	Estimated population standard deviation	Slope	Intercept	SEest[b]	Validity[c]	Slope	Intercept	SEest[b]	Validity[c]
1 Hands-on test	50.8	14.58	.23	34.89	9.73	.21	.76	6.79	8.93	.45
2 Written test	48.8	13.77	.35	25.35	8.71	.34	.58	15.27	8.60	.37
1 + 2	49.2	16.40	.38	22.89	8.99	.36	.89	2.36	8.05	.55

Part B: Predicted Performance Scores

	Electronics Repair Composite score						AFQT score				
Variable	95	100	105	110	115	120	50	58	73	87	96
1 Hands-on test	46	47	48	49	50.	52	42	44	49	54	57
2 Written test	42	44	45	47	49	51	42	44	47	51	54
1 + 2	40	42	44	46	49	51	39	41	47	53	57

[a]Number of cases is 59.
[b]Standard error of estimate.
[c]Uncorrected validity coefficients.

TABLE 19

REGRESSION OF PERFORMANCE ON ASVAB--AUTOMOTIVE MECHANIC[a]

Part A: Regression Equation

Performance measure			Mechanical Maintenance Composite				AFQT			
Variable	Sample mean	Estimated population standard deviation	Slope	Intercept	SEest[b]	Validity[c]	Slope	Intercept	SEest[b]	Validity[c]
1 Hands-on test	49.6	10.57	.29	29.24	8.70	.49	.26	34.38	9.64	.26
2 Written test	50.2	11.29	.29	30.00	8.66	.49	.35	29.81	9.30	.35
1 + 2	50.0	11.33	.36	25.01	7.99	.60	.37	28.32	9.27	.37

Part B: Predicted Performance Scores

	Mechanical Maintenance Composite score							AFQT score					
Variable	80	85	90	95	100	105	110	31	40	50	58	73	87
1 Hands-on test	44	45	46	48	49	50	52	48	49	50	52	54	56
2 Written test	44	46	47	48	50	51	53	48	50	51	52	55	58
1 + 2	43	44	46	48	50	51	53	47	49	51	52	55	59

[a]Number of cases is 131.
[b]Standard error of estimate.
[c]Uncorrected validity coefficient.

TABLE 20

REGRESSION OF PERFORMANCE ON ASVAB--INFANTRY RIFLEMAN[a,b]

Part A: Regression Equations

Performance measure			Combat Composite				AFQT			
Variable	Sample mean	Estimated population standard deviation	Slope	Intercept	SEest[c]	Validity[d]	Slope	Intercept	SEest[c]	Validity[d]
1 Hands-on test	50.4	10.94	.28	23.62	9.44	.37	.24	38.04	9.40	.38
2 Written test	51.0	10.93	.35	17.54	7.82	.52	.29	36.07	7.88	.51
1 + 2	50.0	11.69	.38	13.66	8.59	.51	.32	33.52	8.54	.52

Part B: Predicted Performance Scores

	Combat Composite score							AFQT score				
Variable	75	80	85	90	95	100	105	25	31	40	50	58
1 Hands-on test	45	46	47	49	50	52	53	44	45	48	50	52
2 Written test	44	46	47	49	51	52	54	43	45	48	51	53
1 + 2	42	44	46	48	50	52	54	44	45	48	52	54

[a]Number of cases is 241.
[b]Includes subtests from ASVAB forms 6, 7, 8, 9, and 10.
[c]Standard error of estimate.
[d]Uncorrected validity coefficient.

50 percent below. The standard deviation of performance scores in each interval is the standard error of estimate, assuming homoscedasticity in the regression of performance on the ASVAB. The standard errors of estimate are shown in tables 18, 19, and 20. The ones we use in these computations are: 8.99 for the Ground Radio Repair skill, 7.99 for the Automotive Mechanic skill, and 8.59 for the Infantry Rifleman skill.

To obtain the distance in standard deviation units at the midpoint of each interval, we computed the difference between the predicted performance score and the satisfactory score, and divided the distance by the standard error of estimate. The computation of the percent satisfactory in each ASVAB score interval is illustrated in figure 1. We diagrammed the percentage above satisfactory in the intervals 90-99 (midpoint is 95) and 110-119 (midpoint is 115). The predicted performance score for an EL score of 95 is 40, which is 2 points, or .22 (2/8.99) standard errors of estimate, below the satisfactory score. In a normal distribution, about 9 percent lies between the mean and the point .22 standard deviations away from the mean. This 9 percent is added to the 50 percent below the regression line. Thus, 59 percent in the interval 90-99 has unsatisfactory performance scores and 41 percent has satisfactory scores. In the interval 110-119, 78 percent is satisfactory. In this case, the regression line is above the satisfactory score and the 28 percent (.77 standard errors of estimate above the satisfactory score) is added to 50 percent. Computations for the other intervals are made in the same way.

The percent satisfactory in each aptitude composite interval is shown in figures 2, 3, and 4 for the Ground Radio Repair skill, Automotive Mechanic skill, and Infantry Rifleman skill, respectively. In figures 5, 6, and 7, we show the percent satisfactory for each AFQT score interval. The AFQT intervals we used are:*

Category IVA, percentile scores 21-30; midpoint is 25

Category IIIB, percentile scores 31-49; midpoint is 40

Category IIIA, percentile scores 50-64; midpoint is 58

Category II, percentile scores 65-92; midpoint is 78

Category I, percentile scores 93-99; midpoint is 96.

These AFQT score intervals are commonly used in personnel decisions.

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* No percentages are shown in categories IVA and IIIB for the Ground Radio Repair skill because of the large uncertainties in estimating values at this distance from the sample mean.

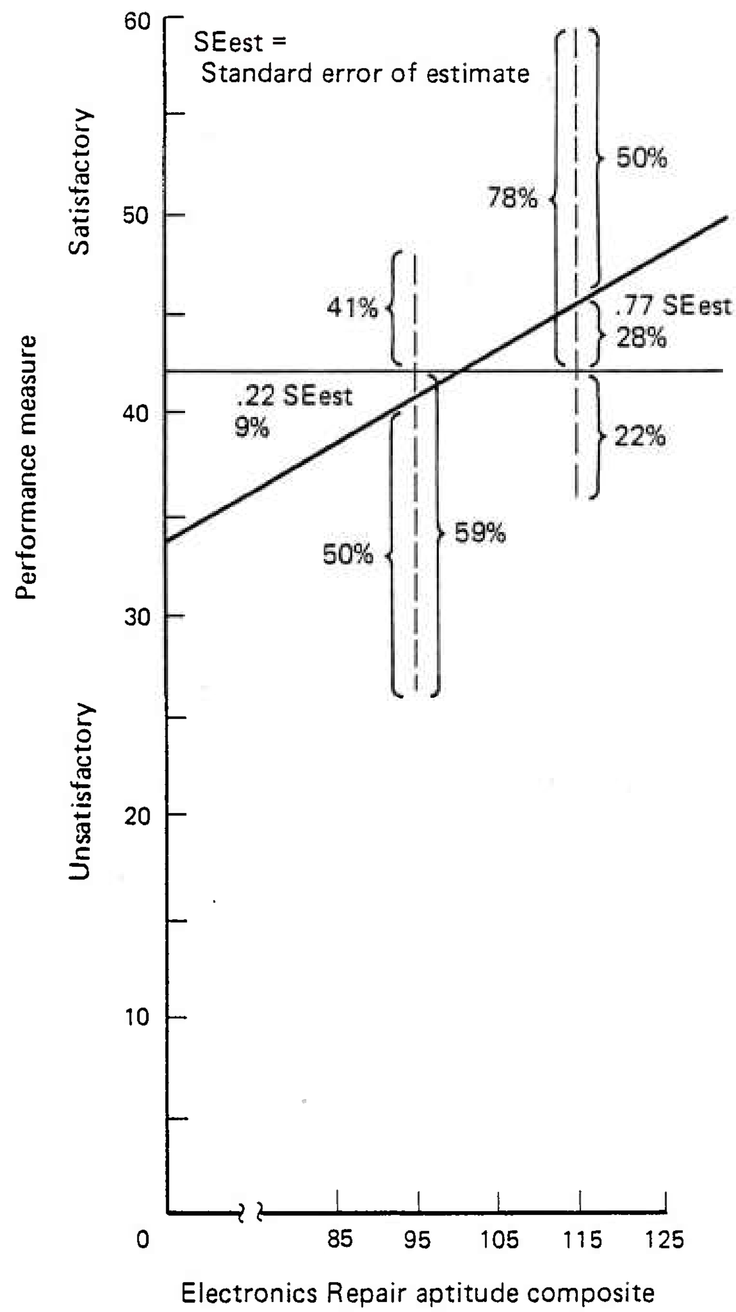

FIG. 1: REGRESSION OF PERFORMANCE MEASURES ON ELECTRONICS REPAIR APTITUDE COMPOSITE — RADIO REPAIR SPECIALTY

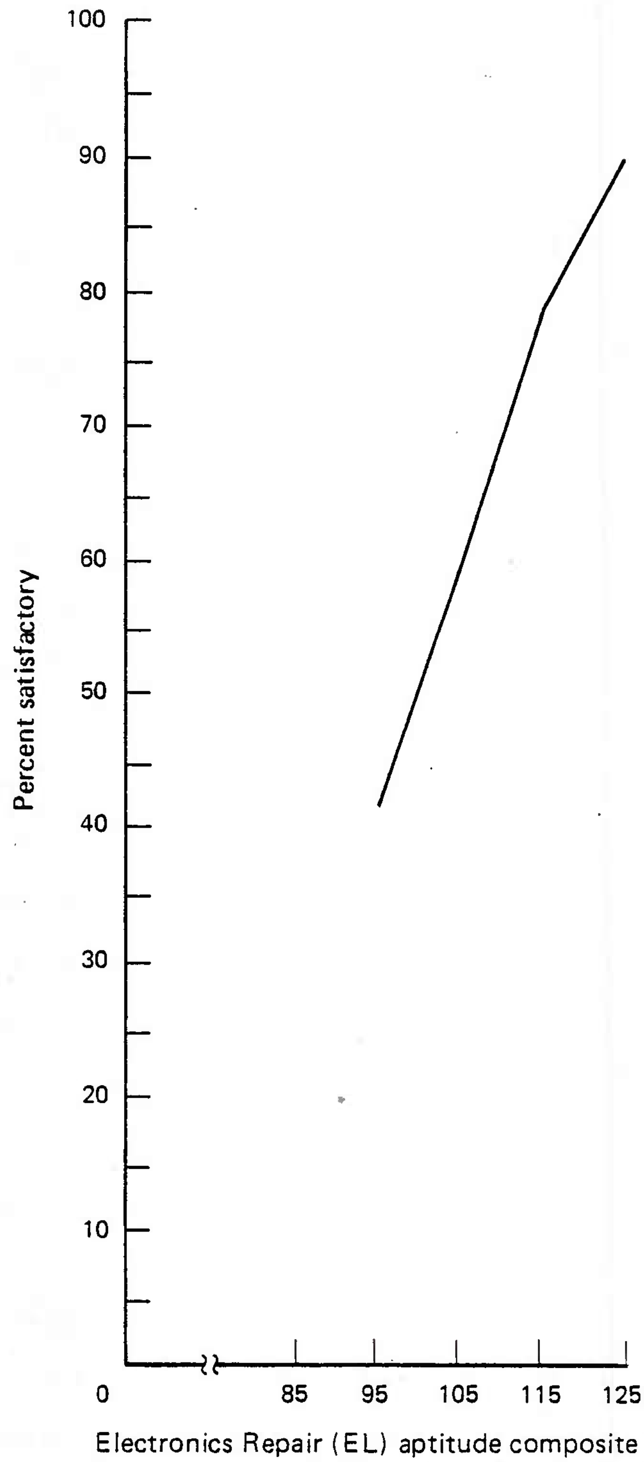

FIG. 2: PERCENT SATISFACTORY PERFORMERS BY EL APTITUDE COMPOSITE – GROUND RADIO REPAIR

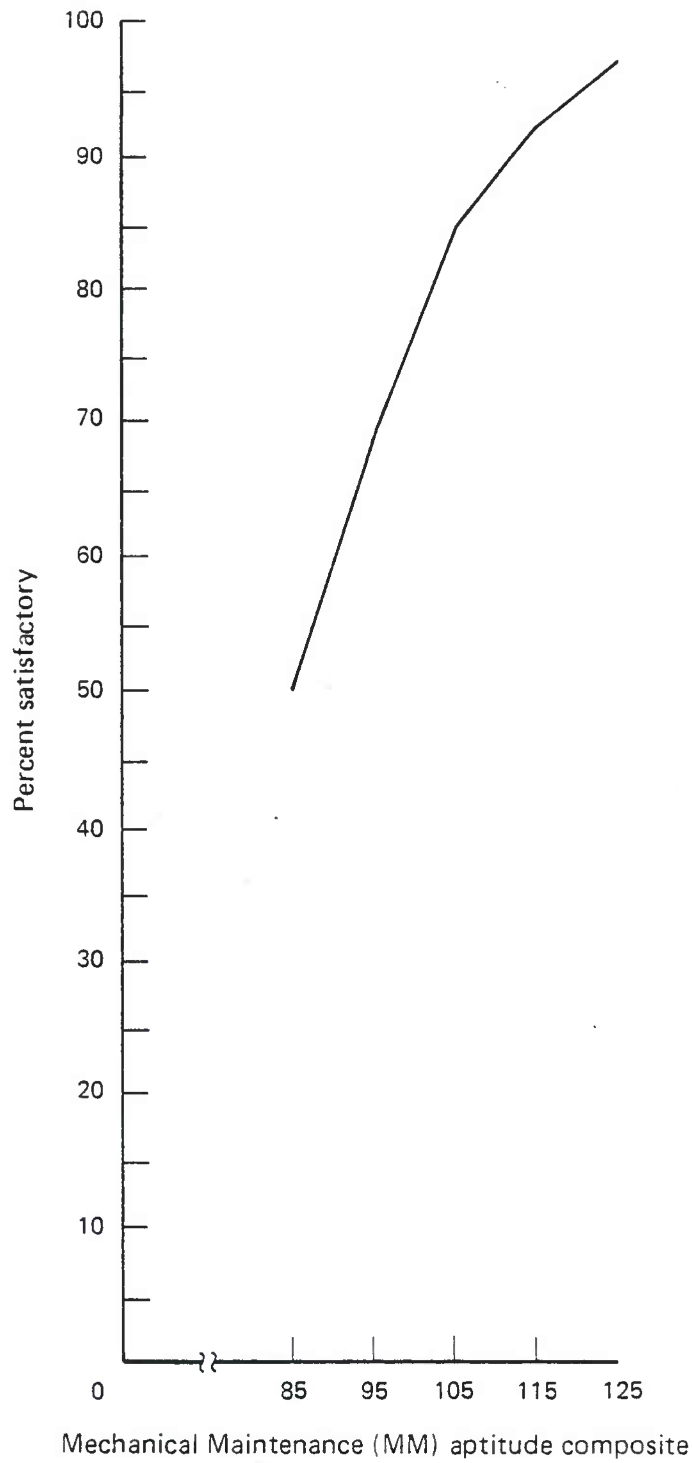

FIG. 3: PERCENT SATISFACTORY PERFORMERS BY MM APTITUDE COMPOSITE – AUTOMOTIVE MECHANIC

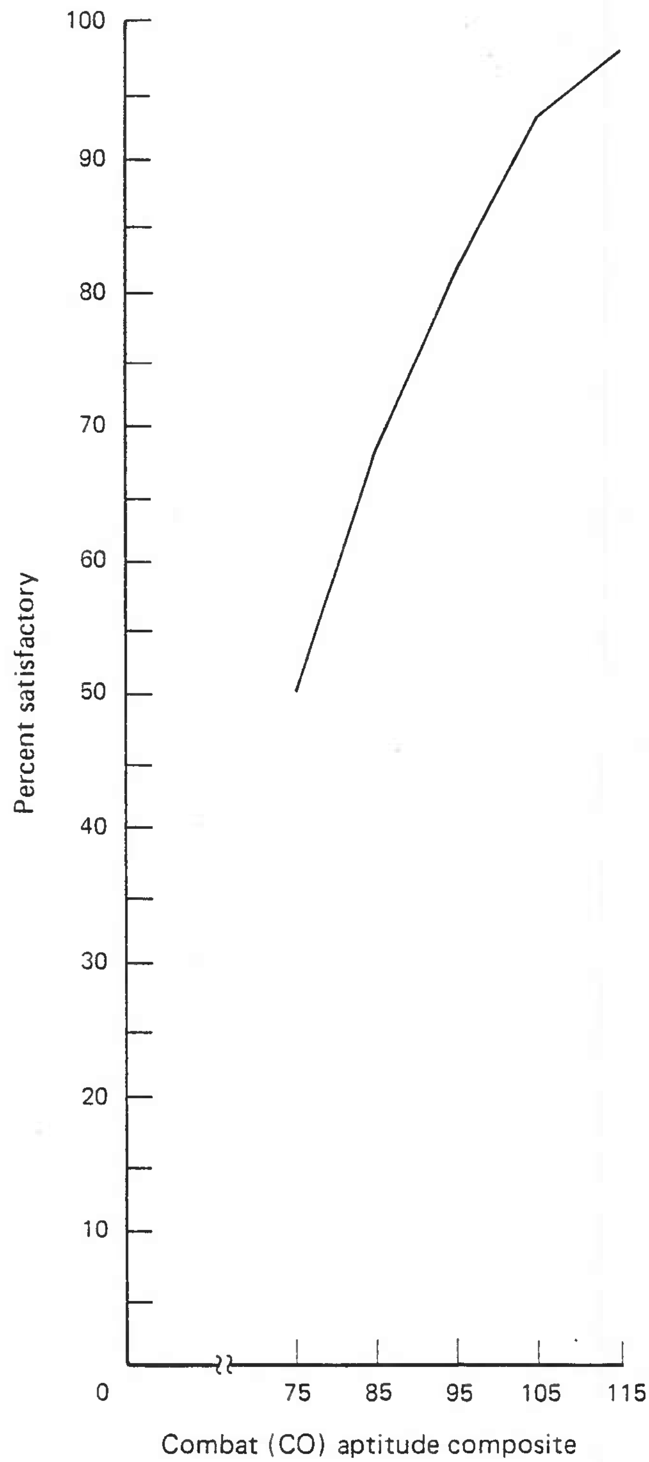

FIG. 4: PERCENT SATISFACTORY PERFORMERS BY CO APTITUDE COMPOSITE – RIFLEMAN

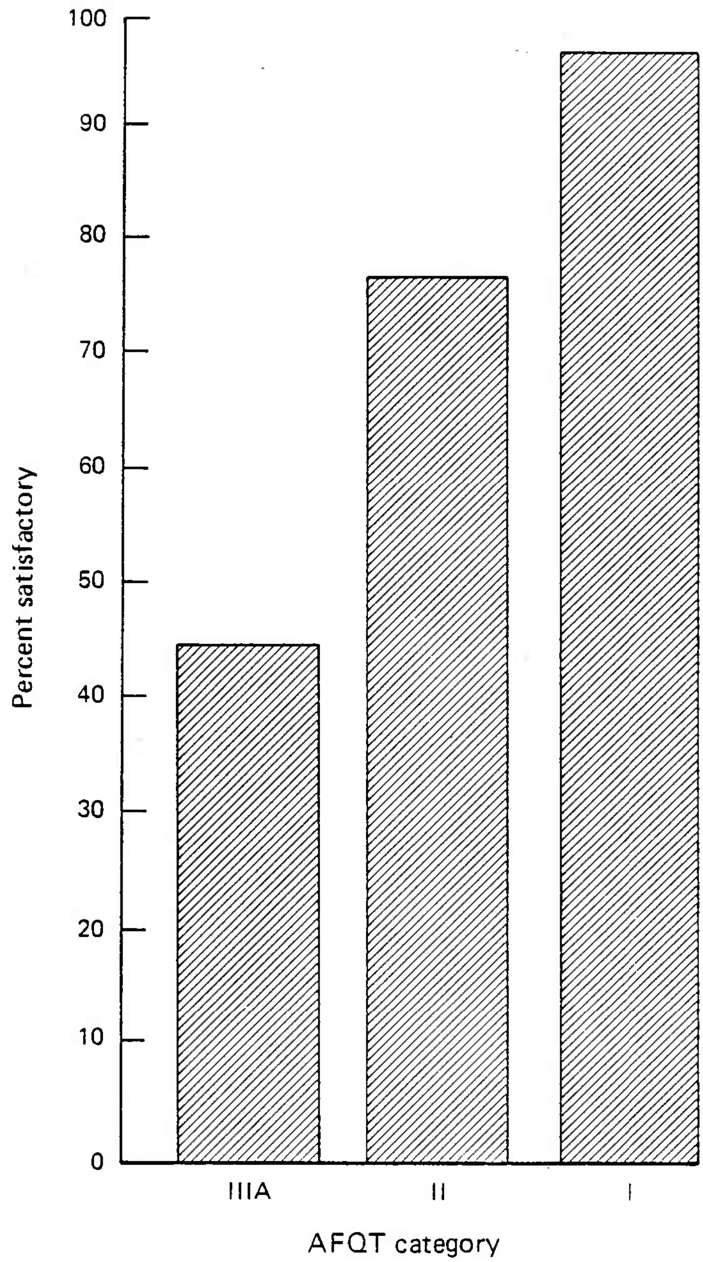

FIG. 5: PERCENT SATISFACTORY PERFORMERS BY AFQT CATEGORY – GROUND RADIO REPAIR

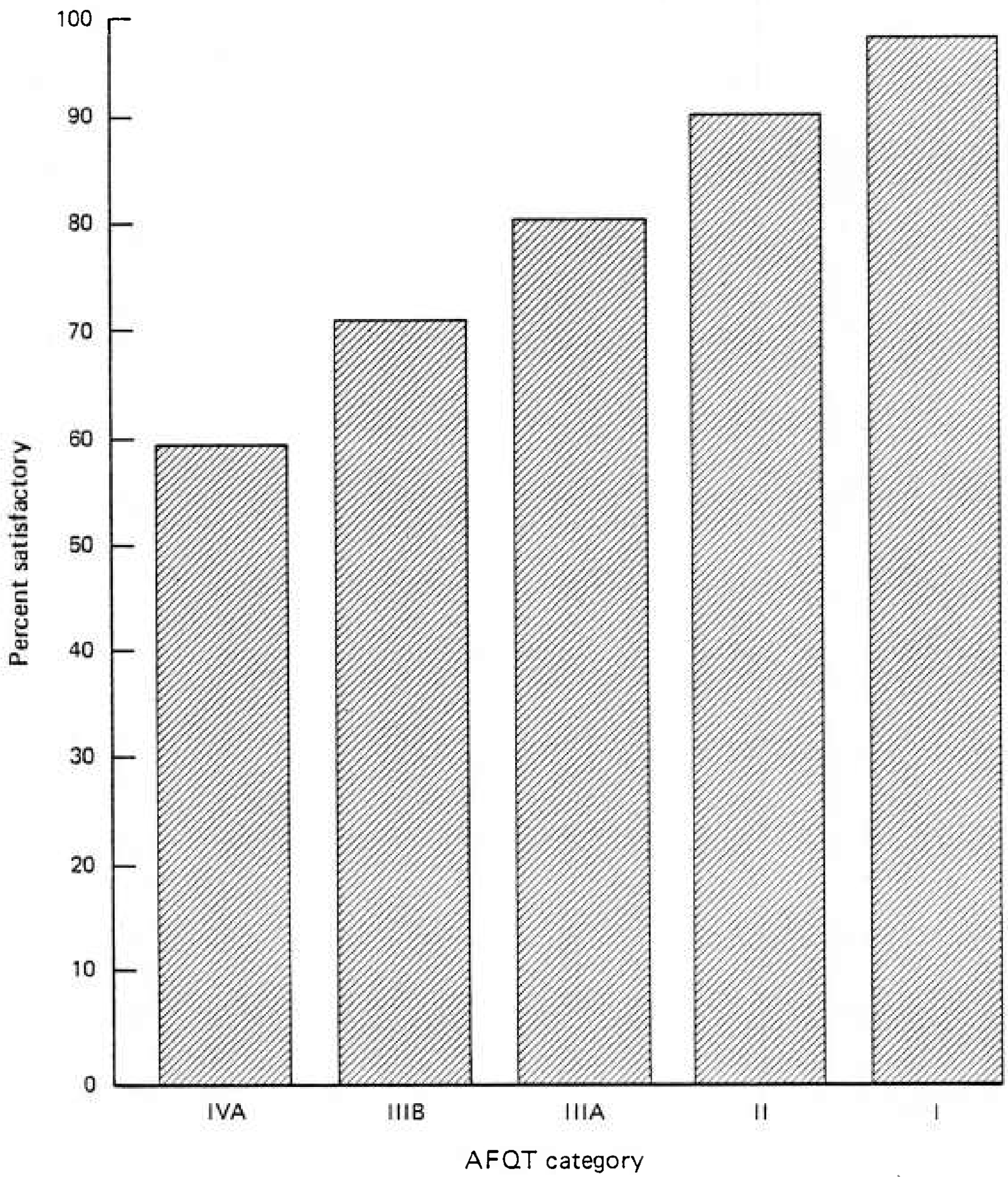

FIG. 6: PERCENT SATISFACTORY PERFORMERS BY AFQT CATEGORY — AUTOMOTIVE MECHANIC

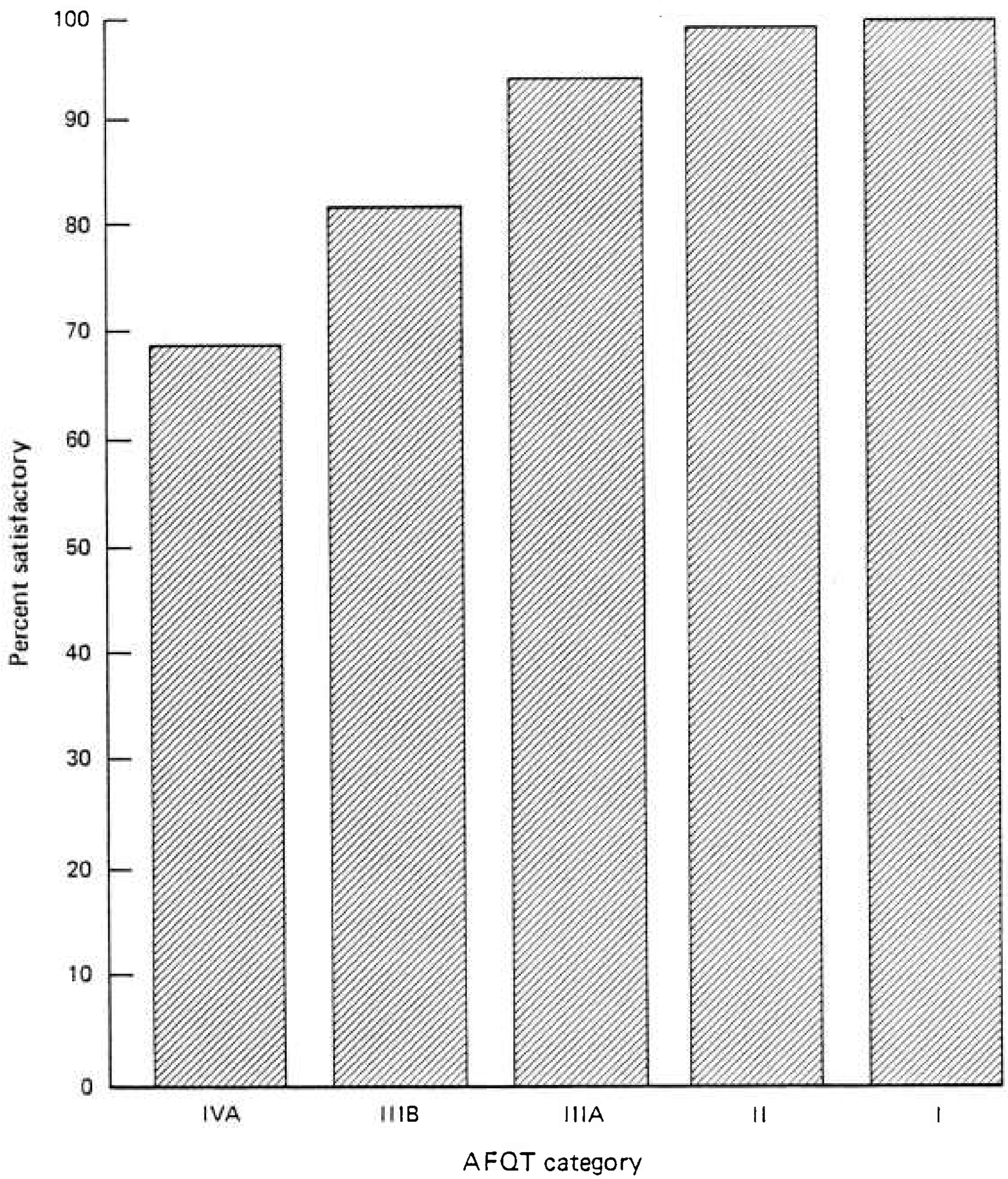

FIG. 7: PERCENT SATISFACTORY PERFORMERS BY AFQT CATEGORY – RIFLEMAN

The results clearly show that the percent of satisfactory performers increases as the ASVAB scores increase. These percentages reflect the relatively high validity coefficients of the ASVAB for predicting performance on the proficiency tests.

SUMMARY

In this chapter we computed a set of qualifying ASVAB scores that were validated against measures of job proficiency. These standards agree closely with the current standards the Marine Corps uses to assign recruits to these skills. The results show that enlistment standards and qualifying standards for assigning recruits to skills can be validated against job performance.

A more thorough validation of standards can be accomplished by including more complex cost figures and performance scores. The cost figures could include costs of recruiting people to enlist in the Marine Corps and costs of attempting to train recruits who prove to be unsatisfactory performers. The performance scores could include duration of satisfactory performance, where benefit to the Marine Corps increases with length of satisfactory performance. A more thorough validation of standards is planned in a follow-on research effort.

CHAPTER 4

DISCUSSION AND CONCLUSIONS

In this report we have addressed two basic questions about performance measures: What characteristics do performance measures have? How do we measure their quality? To answer these questions we relied heavily on statistical analysis of scores that represent performance. From a measurement point of view, the analysis made sense. We concluded that, in general, we had three satisfactory measures of performance.

Evaluation of job performance, however, is more than simply making observations on workers and converting them to numbers. As discussed in the opening chapter, the fundamental consideration in measuring performance is content validity. Content validity, in contrast to predictive validity, is not determined simply by computing the correlation between two sets of numbers. Content validity involves deciding what a job is, defining procedures for identifying content of the measures and for observing behavior, and then converting the observations to numbers for completing the analysis. If the observations have a poor content foundation, the analysis, of course, cannot provide much meaningful information. In this chapter we discuss some philosophical and procedural issues for evaluating job performance.

Our focus is on constructing hands-on and written proficiency tests. These types of tests are constructed specifically as instruments to evaluate job performance. Training grades are routinely obtained by the Marine Corps and used for making personnel decisions; therefore, other considerations in addition to those discussed in this chapter apply to their development. Job proficiency tests used for research purposes ordinarily are subject to more rigorous development and administrative procedures than are measures used for assigning grades in skill training courses. In general, researchers are able to exercise more control over the quality of the tests they can design from their inception, than over the quality of training grades that are provided by the personnel system.

Measurement of job performance is done for a variety of purposes. Three common purposes are to identify training deficiencies; to help in personnel decisions, such as promotion and retention; and to use as criterion measures for validating selection and classification tests. The proficiency tests used in this study were developed especially for the last purpose. Although they may have usefulness for other purposes, we have considered them only as criterion measures for validating the ASVAB.

In this chapter we discuss some issues surrounding the use of job performance tests as criterion measures for validating qualification standards. In chapter 1, we considered the fundamental issue of content

validity--how should a job in the military environment be defined and who should define job requirements? Job experts are key to these decisions, but their work too should be reviewed and approved from a policy point of view. In this chapter we address the issue of scoring the measures. The question of scoring is one of defining and maintaining standards. The standards issue starts at the smallest unit of observable behavior (answering an item or completing a step of a task) and extends to satisfactory-unsatisfactory levels of performance on the job. Expert judgment is required at each level of scoring (step, task, job). Statistical analysis can guide the judgments, but not make them. We discuss the costs of developing, administering, and analyzing job performance tests, and then we close the discussion section by critiquing the performance tests used in this study. Our conclusions consider both the feasibility and cost of using job performance measures to validate qualification standards.

SCORING PROFICIENCY TESTS

Scoring the tests means that observations of performance are converted to numbers. The observation may be of a mark on an answer sheet, for written tests, or of an action taken by the examinee when completing a step in a hands-on performance test. The numbers then must be assigned meaning about level of performance, which requires that we construct a score scale. The examinees' scores are interpreted relative to the scale. Because we want to evaluate examinees' scores according to some reference points, the scores should be obtained under standard conditions and they should be reasonably accurate. In this subsection, we discuss problems with satisfying these scoring requirements.

Converting Observations to Numbers

The general principle for converting observations to numbers is to decompose job requirements into small units that can readily be scored as pass-fail or correct-incorrect. For paper-and-pencil tests, this means a test item; for hands-on performance tests, this usually means a step in performing a task. For written multiple-choice tests, deciding on the correct answer is relatively easy. A panel of experts can review the items and agree on the right answer. Absence of agreement indicates a faulty item. Because of the scoring accuracy and administrative convenience, paper-and-pencil tests have enjoyed great popularity, even as measures of job proficiency.

For hands-on tests, the scoring rules are more difficult to establish and follow. Ordinarily, a task involves a continuous flow of behavior. For measurement purposes, the flow is segmented into observable steps, and then standards are established about passing or failing each step. Test administrators apply the scoring rules to the behavior of examinees as the examinees attempt to perform the tasks. Ideally, all administrators employ the same standards when scoring each step, and they provide identical testing situations, such as using the same verbal

and body language. Later we shall return to problems of standardizing testing conditions.

Attaching Meaning to the Scores

In all tests, the meaning of the scores must be established. The meaning of the scores is always relative to a set of standards. The pass-fail or correct-incorrect score, usually scored as 1 or 0, is relative to the agreed upon correct answer. The 1s and 0s are aggregated to represent performance, and the total score is then placed on a scale. In chapter 3, we spent some time devising a satisfactory-unsatisfactory scale for the proficiency tests. In chapter 2, we used a continuous scale, with no explanations or apologies for what we were doing (except for the need to standardize differences between test administrators). Now we need to examine more carefully how we constructed the score scales.

In chapter 2, we assumed that equal differences between scores had the same meaning, in terms of performance, throughout the scale; that is, a difference of, say, two points at the low end of the scale was equal to a difference of two points in the middle or high end of the scale. Without this assumption, we could not interpret the statistics we used (mean, standard deviation, and correlation coefficient). This assumption is reasonable, except perhaps for the piling up of scores at the high end of the scale for the radio repairers and mechanics hands-on tests. The piling-up of scores usually means that the score scale is compressed, and the true differences in performance are larger than those observed. The effect of the compression is to reduce observed differences among the examinees and weaken the statistical relationships. The credibility of the measures was supported in spite of the compression, and our assumption about the meaning of the scores appears reasonable.

An assumption we did not make is that we could identify a score that meant zero performance. Zero performance would mean that the person cannot meet any of the job requirements. In simple domains, we can reasonably establish minimum levels of competency. Spelling of one-syllable words and addition of two-digit numbers are examples of where a reasonable zero score can be established. Once we move to more complex domains, such as job performance, especially with adult examinees, then zero levels of competence or performance are arbitrary.

Setting Standards on a Performance Test

The argument about a zero point has implications for the meaning of the score scale. In recent years, a movement has grown to use "criterion-referenced" standards to evaluate performance. With criterion-referenced standards, an a priori passing score is established on the measure. Examinees who meet the passing score are said to be satisfactory, or competent, or to have "mastered" the domain. The number of examinees

who attain a passing score is irrelevant to the setting of criterion-referenced standards. Note that the written test items or steps of the hands-on tests use criterion-referenced standards in the sense that the pass-fail score is a priori, regardless of its difficulty. Complications arise, however, when we attempt to characterize performance in a complex skill as satisfactory or unsatisfactory. Aggregating a series of 1s and 0s and then deciding on a passing score for the number of 1s inherently involves arbitrary decisions.

The arbitrary nature of standards is illustrated by the different standards used by the test administrators in this study when they were nominally observing the same performance. In the hands-on testing, conditions were reasonably standardized in contrast to realistic job conditions, and even so administrators employed different standards. Also, standards of satisfactory performance can be varied depending on personnel supply. When competent people are plentiful, personnel managers and unit commanders raise standards. When the need for personnel is great and the supply is limited, as during mobilization, then standards tend to be lowered. Workers can compensate for personal weaknesses, and supervisors can restructure job requirements to capitalize on the strengths of the workers assigned to them. Although there is intuitive appeal to a true zero point of satisfactory performance, in practice, minimum satisfactory performance can be modified with changed conditions.

The score scale we used is called "norm-referenced." In norm-referenced scales, the meaning of the scores is determined by the relative performance of examinees on the measure. We compare scores relative to the other scores in the distribution. We use the mean as the zero point, and assign meaning to scores based on their distance away from the mean.* If a test is easy, then the mean score is high compared to a difficult test, but relative standing of the examinees remains unchanged. With a criterion-referenced scale, the difficulty of the test is crucial to the standing (satisfactory or unsatisfactory) of the examinees.

Given the types of performance measures used in this study, we are willing to assume a norm-referenced scale, and then derive standards from that type of scale. We are unwilling to assume an absolute dichotomy between satisfactory and unsatisfactory performance that is

* Percentile scores, which show rank order in a distribution, are also norm referenced, and they provide essentially the same information as distance from the mean.

based on realistic job requirements. We plan to continue with norm-referenced scales in future research efforts unless new evidence emerges that criterion-referenced standards are meaningful for military skills.

Proficiency Versus Productivity

The preceding discussion about the meaning of the test scores emphasized their arbitrary nature. The score scale for the proficiency tests, as for training grades, is an abstraction that cannot be translated into units of production. From these scores, we cannot tell how many radios a repairer can fix each day, or how many jeeps a mechanic can tune up, or how many enemy troops a rifleman can render harmless. The scores only tell us which examinees are better than others.

The test scores do not permit inferences about tradeoffs between number of workers and performance. We cannot say, for example, that two people with a score of 40 are equal to one person with a score of 60 or 80, or for that matter, any combination of people and scores. The score scale is too weak to permit extrapolations into how much work people can produce in the normal job environment.

If the score scale is that weak, how do we know that it is measuring anything of value? The best evidence we have is from the procedures used to construct the tests. Job experts said that the content reflects job requirements. If their judgments are wrong, then the tests have no content validity. Even if their judgments are right, we still must proceed by assumption. We cannot set up an experiment to demonstrate that the score scale accurately reflects performance on job requirements. The best evidence is agreement among job experts, supported by statistical analysis. We can build a plausible argument that the scores provide meaningful information. Strictly speaking, the meaning is limited to inferences about relative performance in a testing environment. We assume that we can generalize from test scores to performance on the job, but we cannot build a confidence interval. Neither can we tell supervisors or managers how to convert the scores into units of production on the job. The tests were designed as criterion measures for validating the ASVAB, and the score scale does permit such a use.

Standard Testing Conditions

Because the reason for placing test scores on a scale is to attach meaning to them, scores that have the same value should reflect the same level of performance. The best way to ensure equal meaning of the scores is to use standard testing conditions. If all examinees perform the same tasks, and the same scoring rules are applied equally to all examinees, then the same scores tend to have the same meaning.

In chapter 1, we discussed the content of the tests, and one possibility is to construct a different test for each examinee to cover unique job requirements. Such a procedure violates standard testing conditions, and special procedures are required to put all scores on the

same scale. The tests would need to be equated or calibrated before the scores can be compared.

The experience of the military services in equating or calibrating different versions of the ASVAB is instructive for putting the different performance tests on the same score scale. In the testing jargon, we speak of equating tests if they have parallel content; if they have somewhat different content, then we speak of calibrating them. The equating of tests is invariant; the equality of the scores applies to all possible samples of examinees. Calibration, however, is sample unique. In calibration, different scores can be set equal to each other depending on the characteristics of the sample used to calibrate the tests. If the different performance tests are parallel, which means they are measuring the same thing except for trivial differences in the content, then putting them on the same scale is relatively easy. If they are measuring the same thing, however, there is no need to develop a different test for each duty assignment. The different tests, therefore, must be measuring somewhat different things, which means we cannot be certain that the same scores mean the same level of performance.

When ASVAB tests are equated, the preferred sample size is about 2,000 examinees. Calibrating two tests requires even larger samples to help obtain representativeness and permit generalization to the population of examinees. Given the expense of administering hands-on performance tests, there is no way that adequate samples can be obtained. With the sample sizes that are feasible, say up to 100 examinees who would take exactly the same test, the calibration remains dubious. Comparison of examinees, on either a criterion-referenced or norm-referenced scale, tested with different performance measures, then could not be done with confidence.

COST OF JOB PERFORMANCE TESTING

Developing and administering job performance tests, especially the hands-on tests, is expensive in terms of money and people. The approximate costs to the Marine Corps for developing, administering, and analyzing the job performance tests used in this study are shown in table 21. The development costs for these tests are an absolute minimum. Future efforts to develop job performance tests would be more costly. The figures are based on Marine Corps experience for the three tests developed for this study, and adjusted to incorporate decisions about sample size made by the Joint Services Job Performance Measurement Working Group.

Test Development

The test development process requires close coordination between job and testing experts. The job experts should be intimately familiar with the job requirements, including experience in performing the job tasks themselves and in supervising the performance of others. One of

their tasks is to translate job requirements into terms and concepts commonly used by workers in the specialty. The testing experts should know how to structure job requirements to enhance test validity and how to exercise quality control.

TABLE 21

APPROXIMATE COSTS OF A JOB PERFORMANCE TEST

Activitity		Cost	
		Days	Dollars
Test Development			
Test experts		190	80,000
Job experts		250	30,000
Overhead			55,000
	Subtotal		165,000
Test administration			
Examinees		400	40,000
Administrators		400	50,000
Overhead			45,000
	Subtotal		135,000
Analysis and reporting			
Analysts		125	60,000
	Total		360,000

Structuring the job requirements means that the test content includes only skills and knowledge essential to performing job tasks and excludes trivial bits of information. A key component in the developmental process is the task analysis, in which the steps required to perform a task are clearly specified. These steps serve as the building blocks for constructing the hands-on and written tests. The job experts specify the steps, and the test experts help translate the steps into test content. Before the tests are administered to the large sample, they should be tried out on small groups to make sure they provide valid measures--scoring accuracy, consistency of measurement, and no complaints about unclear directions or questions.

The time required to develop job performance tests used in this study was about 9 months of testing expert's time. At about $110,000 per professional year, the cost to contract for testing experts is $80,000. More time of the job experts is required, but at a lower cost. Two job experts, each working about 6 months, were involved in constructing their tests. The cost for job experts, who normally are noncommissioned officers, is about $30,000 per year. This figure

includes costs for pay and allowances (P&A) and for organization and maintenance (O&M); other costs such as retirement and travel are not included. The overhead cost of $55,000 included managers from Marine Corps Headquarters (3 months), local support from the installation where the tests were developed (4 months), CNA analysts (2 months), and travel. The cost for developing a test, including tryout and evaluation was $165,000.

Test Administration

Administering hands-on performance tests is expensive because only one examinee can be tested at a time by a test administrator. The costs are based on 400 examinees in the sample, each tested for a full day, and 400 days of test administrator time. The examinees typically are first-term enlisted personnel, who cost about $100 per day for pay and allowances and for organization and maintenance costs. The Job Performance Working Group has decided that 300 examinees constitute an adequate sample for validation purposes. To obtain 300 usable cases, we estimate that 400 examinees need to be scheduled.

To test the 400 examinees, 400 mandays of test administrator time need to be allocated. Even though the Marine Corps hands-on test lasted only one-half day, a full day of administrator's time was required. The extra time was spent setting up and maintaining equipment, scheduling examinees, and taking time to regroup. The test administrators cost about $125 per day, or $50,000 for 400 mandays. These costs are for military test administrators, but the cost for civilians would be about the same.

The overhead cost of $45,000 for test administration included management by Marine Corps Headquarters (2 months) and by the local installation (3 months), plus 2 months of an analyst's time to help exercise quality control over the way hands-on tests are administered and scored.

Analysis and Reporting

Analysis of the data and preparation of a report required about one-half of a professional year. The figure of $60,000 included the time of research assistants, editors, managers, and analysts. The analysis cost would be considerably higher if the costs of recruiting and training Marines were considered more systematically than we did; such a comprehensive analysis, which helped provide the impetus for the joint-service project, was conducted by Armor [7].

The total cost to develop, administer, and analyze a job performance test was about $360,000. The cost per examinee with usable data was over $1,000. For research purposes, where a limited number of specialties are tested, the expense is tolerable. Should, however, job performance testing be conducted for a large number of specialties, the

costs would add up quickly. The Marine Corps, the smallest of the services, has over 60 specialties with more than 100 new recruits assigned each year. These specialties would provide enough examinees to permit validation of qualification standards. The cost for one-time testing of the 60 specialties computed at the same rate would be over $20 million (60 x $360,000). If the tests were recurring or if they also covered second-term personnel, the costs would be even higher.

In addition to monetary and personnel costs, there are hidden costs to the installations where the tests are administered. Testing disrupts the normal activities of units. Noncommissioned officers are in short supply, and units are reluctant to release them for working on the tests. Units are also reluctant to dedicate expensive equipment, such as trucks, tanks, or planes, to support the testing. Widescale testing would impose an onerous burden on units and therefore is not feasible.

The Joint Services Job Performance Measurement Working Group has wisely decided that a major goal of the research program is to find valid measures that can be used in lieu of the hands-on performance tests. A significant component of the research program is the evaluation of training grades as a criterion measure for validating qualification standards. A desirable outcome of the research program is to identify the types of specialties for which training grades, or other less expensive performance measures, can serve as satisfactory criteria to validate qualification standards. For these specialties the expense of hands-on testing can then be avoided.

CRITIQUE OF THE PROFICIENCY TESTS USED IN THIS STUDY

The hands-on and written proficiency tests used in this study generally were satisfactory. Copies of the test are contained in [8]. If we were doing the study again, however, we would attempt to have somewhat different tests. The procedures for determining the content areas to cover with tests were appropriate. Job experts were consulted to ensure that the critical requirements were included. When the requirements were translated into observable behavior (written test items and hands-on tests), we would have preferred that the tests place greater emphasis on requiring examinees to apply their skills and knowledge to performing tasks. Many of the written test items asked examinees about abstract facts and principles; by presenting work-related problems and having the examinees say what they would do, we believe the content validity would have been enhanced.

The hands-on performance tests reflected three different design strategies. The radio repair test used a new piece of equipment that no examinee had worked on before. They had to apply their troubleshooting skills during the test. This test should permit maximum generalization to requirements in the skill, but not necessarily describe how well examinees perform the tasks in their current duty assignment. The mechanics test asked the examinees to perform tasks that they normally

encounter in their daily work--tuning up a quarter-ton Jeep and working on the wheels and brakes. Both describe their proficiency in the current assignments and should generalize to the skill.

The rifleman hands-on test was a mixture of doing and knowing, with some stress built in. In the doing parts, they fired their weapons at pop-up targets while negotiating a firing range with explosives going off around them. They also encountered dummies on whom they were supposed to perform first aid. In the knowing parts, they were asked to identify hand signals printed on a card and to identify map symbols. Even with hands-on tests, tasks can be presented abstractly, rather than in a job functional context. In general, the tasks reflect combat requirements, and the realism is a matter of feasibility.

Although the tests probably could be improved, they were adequate for this feasibility study. There are no certain rules for developing proficiency tests, and different people employ different strategies. Perhaps as we gain more experience in building proficiency tests, the researchers and personnel managers can attain greater agreement about what a good performance measure should look like.

SUMMARY AND CONCLUSIONS

The most important conclusion is that it is feasible to validate qualification standards against job performance. The ASVAB is a valid predictor of job performance, as measured by hands-on proficiency tests, written proficiency tests, and grades in skill training. By making reasonable assumptions about the difficulty of the skills and acceptable rates of unsatisfactory performers, we computed a new set of qualifying standards that correspond closely to the current ASVAB standards for assigning recruits to the three skills in the study (Ground Radio Repair, Automotive Mechanic, and Infantry Rifleman). We established the credibility of the three performance measures in terms of content validity and accuracy of the scores. The predictability of the performance measures by the ASVAB conforms to prior experience, and the qualification standards using job performance tests as the criterion measure agree closely with current Marine Corps qualifying standards. Hence, we reach our conclusion that qualification standards can be validated against job performance.

The second main conclusion is that measuring job performance is a complex and expensive process that produces uncertain results. In the lengthy introductory and discussion chapters, we raised some of the issues, problems, and pitfalls related to measuring job performance. Even in those long pages, we skimmed over most of the topics, and many readers will undoubtedly say that we omitted some of the most important ones. Our intent was not to resolve the issues, but to point them out and move toward a possible resolution. One reason we dwelled on the complications is that the military services currently are embarking on an extensive research program to validate qualification standards

against job performance. An interservice working group on job performance measurement was established in fall 1982. The working group is responsible for formulating and coordinating an effective program that satisfies the needs of personnel managers and conforms to good scientific practice. Our hope is that this preliminary effort will be useful to help formulate an effective and efficient research program.

The remaining conclusions will be presented more briefly:

- When developing proficiency tests, panels of job experts should review the procedures and products throughout the entire process to help ensure content validity.

- The agency responsible for developing tests should also have responsibility for scoring them. Complicated test items may appear to have greater content validity, but with extra care they can be made more convenient for both examinees and scorers, with probably little or no loss in validity.

- Inexpensive data, such as ratings, training grades, and ASVAB scores, should be collected before administering the expensive hands-on and written proficiency tests. Testing resources should not be wasted on examinees who must be deleted from the sample because of missing data.

- Test administrators should be trained to provide uniform testing conditions. Administrators should be consistent in the amount and type of help they give examinees and in the scoring standards they use.

- Norm-referenced, rather than criterion-referenced, score scales and standards for satisfactory performance should be used for the type of measures used in this study.

The final conclusion is that even though we can validate qualification standards against hands-on job performance tests, we may not always want to. Perhaps in the technical skills, represented by Ground Radio Repair and Automotive Mechanic in this study, the traditional criterion measure of grades in skill training courses may be satisfactory. In nontechnical skills, represented by Infantry Rifleman, hands-on and written proficiency tests may provide information about performance not available from other sources. Although no firm conclusion can be drawn until the usefulness of training grades as valid criterion measures of performance is documented by an extensive body of research results, they do have sufficient promise as measures of performance that they should be retained for all recruits in all training courses. The grades should be numerical scores as traditionally reported.

In summary, we set out to determine the feasibility of validating ASVAB qualifying scores against measures of job performance. Through extensive correlational analysis, we established the credibility of the performance measures and their predictability by the ASVAB. We computed qualifying ASVAB scores for each skill, and the standards were reasonable. We then presented some topics for consideration when designing further research efforts on validating ASVAB qualification standards.

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APPENDIX A

DEVELOPMENT OF THE PROFICIENCY TESTS

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DEVELOPMENT OF THE PROFICIENCY TESTS

INTRODUCTION

The hands-on and written proficiency tests were developed through the joint efforts of test experts from the Navy Personnel Research and Development Center (NPRDC) and Marine Corps job experts from Camp Pendleton, CA. The team for each test was composed of two job experts and one test expert. The test development procedures and content are described in an NPRDC report [A-1]. In this appendix, we extract salient information from the NPRDC report and supplement it with our observations on the tests.

THE DEVELOPMENT PROCEDURES

The general approach for test development used by NPRDC is as follows:

1. Identify tasks performed in each skill and group them by major task areas

2. Rank the task areas according to how well they predict performance in the skill and rank the tests in each task area according to how well they predict performance in the area

3. Construct hands-on and written tests for the top-ranked tasks, based on their suitability for hands-on or performance-oriented written tests, taking into account logistical feasibility

4. Conduct field tryouts.

Each test was developed by a different team of test and Marine Corps job experts. The teams adapted the general procedures to the unique requirements of each skill.

<u>Ground Radio Repair</u>

Eight Marine Corps job experts reviewed the task areas for the Ground Radio Repair skill. The clear consensus was that the most predictive task area was troubleshooting. Because most circuits are similar, the actual equipment used for troubleshooting was not considered important. To minimize experience with specific pieces of equipment, however, the team decided to use the AN/UIQ-10 amplifier, which had not yet been issued to the field.

Examinees could consult technical manuals and troubleshooting charts during the hands-on and written tests. The hands-on test was tried out on five examinees. The written test was tried out on ten examinees. The team was satisfied with its efforts on the hands-on test:

> Since the examinee recorded his troubleshooting diagnosis on an answer sheet, the examiner was not required to make any judgments as to what procedures were followed. Therefore, scoring was completely objective and scoring reliability posed no problem. The only problem worthy of note was the time required to procure, install, and check the three AN/UIQ-10 amplifiers and all the instruments and materials needed (pp. 8 and 9).

In the development of the written test "no problems worthy of note were encountered."

<u>Automotive Mechanic</u>

Initial efforts to identify task areas covered a broader scope of job requirements than those specific to the organization level automotive mechanic. The first set of job experts ranked the comprehensive set of requirements that included vehicle recovery, electrical systems, and intermediate level of maintenance, as well as organizational level. The two Marine Corps job experts assigned to the test development team decided that a major engine tune-up of the M-151 Jeep would be the best predictor of proficiency of the organizational level Automotive Mechanic skill. The tune-up was supplemented with a test on wheel and brake maintenance. The hands-on test was tried out on six examinees. The written test focused on the M-54 truck with a multifuel engine. The written test was tried out on the six examinees who took the hands-on test, plus three others.

Scoring the hands-on test was not perceived as a problem:

> The two job experts, who had developed the tests, observed the six subjects independently during the field tryout and eliminated scoring ambiguities as they appeared. As a result, by the end of this period, the two experts were in perfect agreement and scoring reliability seemed to pose no problem. However, it should be noted that, as was true of the other skills, the original tryout plan called for five additional examinees to check scoring reliability, but they could not be provided....It is believed that additional tryouts would have yielded the same results (i.e., the tests would have very high scoring reliability), because steps within the tests were carefully constructed to be very specific and objective (p. 6).

Infantry Rifleman

For the Infantry Rifleman skill, 16 major test areas, and tasks in each area, were ranked by 87 Marine Corps job experts. The hands-on tests were intended to parallel combat conditions as much as possible, but to avoid conditions that could cause injury. The hands-on test was administered to 81 examinees--~~ten~~ groups of 5 to 8 at a time. The two job experts, plus a third job expert, scored the tests in the final tryout "with virtually perfect agreement." The NPRDC report does, however, raise some cautions about administering the hands-on test for riflemen:

> Some examiners departed from the prescribed instructions for administering some hands-on tests by ad-libbing, rephrasing questions, inadvertently giving clues to the answer by gestures, and providing more orientation to a test than prescribed. Some NCO examiners had difficulty in avoiding 'training' the Marine instead of testing him. These difficulties were eliminated by conducting training classes for the examiners (p. 4).

The written test was also administered to the same 81 Marines who took the hands-on test. Although some examinees had difficulty in reading certain test items, this problem was "mitigated by carefully rewriting those items. No other problems worthy of note were encountered in developing the rifleman written test" (p. 4).

The test development procedures conformed to current state-of-the-art practices for proficiency testing. Job experts were intimately involved throughout the process, which should enhance content validity.

SCORING THE TESTS

Test booklets and answer sheets started arriving at CNA in about September 1981. We started scoring them immediately. Scoring the rifleman tests was not completed until September 1982, a year later.

Most of the tests used were scored using computer programs. The examinees' responses to each item on the written tests and the administrative notation of either pass or fail for each hands-on test were entered into a data base for each skill. Programs were written to score each test in accordance with the scoring schemes devised by the job experts. Scores were then computed for examinees by processing their responses through the appropriate scoring program.

Ground Radio Repair

Scoring the Ground Radio Repair tests was fairly straightforward, but did have some complexities. The written test had two parts. The first contained 52 items, and the second had 7. Part one consisted of

38 unit weighted multiple choice questions; the responses were recorded on a separate answer sheet. The remaining questions of part 1 were worth 1, 2, or 3 points, with the weight for each question specified by the job experts. Seven of these remaining questions were open ended; with points awarded based on the precision of the response. Part 2 consisted entirely of multiple choice questions. Three points were awarded for each correct response. A total written score was calculated by summing the scores of parts 1 and 2.

Most of the hands-on portion for the Ground Radio Repair skill was scored by the administrator while giving the test. The hands-on test had 10 scorable units that were divided into three stages: identify faulty symptom, circuit, and component. Examinees' responses to each step were recorded on an answer sheet. The point value associated with steps of identifying the faulty symptoms and circuits were recorded along with the response. Identifying the faulty component was scored by hand using a given scoring pattern ranging from 0 to 8. This pattern was based on the number of attempts the examinees made at identifying the faulty component. Each examinee was allowed as many attempts as desired within the given time limit of 30 minutes per board, and 210 minutes total testing time. No feedback was to be given concerning the accuracy of the response because the scoring rules involved a penalty by progressing from a correct to incorrect response. The individual responses to each step were fairly lengthy; therefore, just the points scored on each step were entered into the data base. The time required to complete each of the circuit boards was also entered into the data base. An efficiency score was calculated. However, the efficiency scores were not found to be meaningful.

Automotive Mechanic

The scoring scheme for the Auto Mechanics was the most straightforward of the three skills. The written test consisted of 61 multiple choice questions. The examinees wrote the letters corresponding to their response choices on a one-page answer sheet. The scores were calculated by awarding one point for each correct response.

The hands-on test consisted of 81 steps. The test administrator completed a step-by-step checklist for each examinee by recording either a pass or fail in accordance with the examinee's performance on that step. The time required to complete the tasks was also recorded. This information was used in the calculation of efficiency scores. The hands-on score was computed by awarding one point for each step passed. The efficiency scores were calculated by dividing the hands-on score by the time required to complete the task. The administrative instructions stated that three points were to be awarded if specified subsets of steps were completed in a given order. However, the test booklets did not give any information as to the order of actual completion; therefore, all steps were unit weighted.

Infantry Rifleman

The tests for Infantry Rifleman skill were much longer and more complex than the other two skills. The written test contained 129 questions. Responses to each question were recorded by the examinee in space provided in the 18-page test booklet. Twenty-three questions followed a multiple choice format in which the examinees indicated their response selection by checking the space provided next to the response choices. The remaining items were matching-type questions for which the examinee selected the appropriate answer from a list of several, up to 79, possible alternatives. The number corresponding to the selected response was then written in the space provided.

The scoring program for this test was extremely complex. Most of the questions were clustered so that several drew responses from the same matching list. Special care had to be taken not to award double credit for duplicate answers within subgroupings that did not allow them. Several subgroupings required a specific order of responses. Credit was awarded only until the order was broken, regardless of the remaining responses. Most correct answers were awarded one point. However, several were given a half point, while still others were worth two or three points. In the subgroupings requiring a given order, a bonus point was given if all steps were completed correctly. This allocation of point values was, like the other skills, designed by the job experts.

The hands-on test covered 176 steps, worth a total of 332 points, including negative points for serious errors. These steps were completed at various testing stations located throughout the compound. A pass or fail was recorded for each step, and one point was awarded for each step executed successfully. Unlike the other tests, examinees were penalized for not completing certain items satisfactorily. These penalties ranged from one to five points, as specified by the job experts.

Because the hands-on test was completed in various stages and locations, the tests were plagued with missing data. Several examinees were missing one or two subsections of the test. For these cases we estimated the scores for the missing sections, using a multiple regression equation calculated for the 339 complete cases. We felt this would be the best estimate of performance because it was based on the examinee's performance in similar situations.

MEASURING JOB EXPERIENCE

Developing measures of job experience, just like developing measures of job proficiency, involved many decisions. We had to decide how to define experience. For technical jobs, civilian and military training and experience should cumulate. Some experience is more valuable than others. For example, in electronics repair, workers at the organizational level of maintenance rarely repair circuit boards or

other components. They are more likely to identify the faulty component, replace it, and then send it to a higher echelon of maintenance for repair. The implication is that radio repairers assigned to the organizational level of maintenance would receive little practice in identifying faulty components in circuit boards. Radio repairers at support levels would perform these tasks more frequently.

Ground Radio Repair

For the Ground Radio Repair skill, we measured job experience in terms of months since completion of formal school training, weighted by amount and type of maintenance responsibilities in duty assignments. The echelons of maintenance are numbered 2 for organizational and 3 or 4 for support. We multiplied months since completion of school by the number for the echelon. Finally, we also multiplied months by the percentage time spent in repairing equipment, as opposed to performing other duties. We assumed that the higher the echelon of maintenance the more valuable the experience. In appendix B we report the correlation between measures of experience and the performance measures.

Automotive Mechanic

For the Automotive Mechanic skill we computed a total experience score that included time, training, and exposure to different types of equipment. All examinees were working at the organizational level, and we did not need to take echelon into account. The examinees marked whether they had worked on six different types of equipment; they indicated whether they had paid civilian experience as a mechanic and whether they had civilian training as a mechanic. We calculated the months they had worked as mechanics in the Marine Corps. We summed these scores to obtain a total experience score.

The dominant score was months of experience as a mechanic in the Marine Corps. The other variables contributed little to the correlation between job experience and performance measures.

Infantry Rifleman

Job experience for the Infantry Rifleman is hard to conceptualize. During peacetime, the primary responsibility of infantrymen is to train for combat. For the measure of experience we simply computed the number of months the examinees had in the Marine Corps. The examinees were asked at the time of testing how many months ago they had graduated from the Infantry Training School, but their responses were too unreliable for use in the statistical analysis.

Amount of experience in two of the skills was controlled incidentally when we obtained ASVAB scores of the examinees. We retained only those examinees in the radio repair and mechanic samples who had taken forms 5, 6, or 7 of the ASVAB. These forms were administered between

1 January 1976 and 1 October 1980. A few of the older examinees in these skills had joined the Marine Corps before 1976 and some of the younger ones after 1 October 1980. These samples, then, tended to contain Marines in their first term of enlistment, or early in their first reenlistment; and the mechanics tended to have at least 1 year of job experience in the Marine Corps, while some radio repairers had just a few months. (The training for mechanics takes about 3 months compared to about 8 months for radio repairers.) For the rifleman sample, we retained examinees who were tested with forms 8, 9, and 10 of the ASVAB, which means that some of the examinees enlisted during fiscal year 1981.

DISCUSSION

The statements quoted from the NPRDC report illustrate some of the deceptiveness in attempting to develop and use hands-on performance tests. During the tryout, which is comparable to a research environment, the tests and administrators behaved as expected. Everyone was confident that they would produce accurate scores, which the NPRDC report calls scoring reliability. As we found during the analysis, however, scoring accuracy was not satisfactory. Apparently something changed between tryout and full-scale administration to examinees.

During the tryout, the administrators did not have a vested interest in how well the examinees scored. In fact, because they developed the tests, they probably were more interested in making sure the tests could make the proper discriminations. During full-scale administration, however, a new set of administrators was responsible for the testing. The new administrators had no vested interest in how good the tests were; but being professional Marines, they probably had a vested interest in how well the examinees scored.

The quote about the Infantry sergeants wanting to "train" the examinees typifies the responsibility of supervisors in the military services. During peacetime, the primary job of immediate supervisors is to train junior workers in the skill. Their attitude is to be helpful. When they function as test administrators, we expect them to reverse their attitudes and habits. We want them to function as objective presenters of the tests and evaluators of performance. They should not, we say, intervene in the behavior of the examinees; but by years of training, they expect to intervene. Based on the differences we found among test administrators, some apparently intervened more than others.

The hands-on tests in this study, even in the full-scale administration, were still used only for research purposes. No personnel decisions were based on the test scores. The experience with ratings, and other types of measures, is that the scores become inflated when they are used in personnel decision making. The inflation of the hands-on test scores for the radio repair and mechanic samples we found in this study would probably be increased even further if they had official status in the Marine Corps. Hands-on testing has a lot of appeal, but so far no one has figured out how to keep the scoring accurate.

REFERENCE

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APPENDIX B

DESCRIPTION OF STATISTICAL ANALYSIS

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DESCRIPTION OF STATISTICAL ANALYSIS

In this appendix, we present more details of how the statistical analysis was accomplished and more of the results. In the first part we discuss the effects of deleting cases from the samples because of missing data (i.e., ASVAB scores and training grades). We then show corrections of the validity coefficient because of prior selection of examinees on the basis of their ASVAB scores.

EFFECTS OF DELETING CASES FROM THE SAMPLES

In all samples, the hands-on and written proficiency tests were administered before collection of the other data began. As a result, many examinees were missing one or more sets of data necessary to complete the analysis. In this subsection we present means and standard deviations of proficiency test scores, job experience, and enlisted grade for examinees in each subsample. The analysis proceeded in the following sequence:

- All examinees tested with the hands-on and written proficiency tests
- Examinees with a complete set of ASVAB scores, forms 6 and 7
- Examinees with training grades.

The smallest number of cases in each sample was obtained when we deleted cases that did not have training grades.

Ground Radio Repair

For the Ground Radio Repair skill, cases were also deleted because some examinees had training and experience different from the main body of radio repairers (specialty number 2841). One group of 19 examinees received only 8 weeks of training to prepare them for working at the organizational level of maintenance (specialty number 2845). Another group of 10 examinees was trained on aviation radio repair (specialty number 5937); this group omitted portions of the written test that pertained exclusively to ground equipment. As a result their scores were not comparable, and they were deleted.

The mean and standard deviation for the examinees in each specialty are shown in table B-1. The proficiency tests are reported for all groups, and Electronics Repair (EL) aptitude composite scores are reported when available. Examinees trained to perform support-level repair (2841) performed better than those trained to perform

organizational-level maintenance (2845) on both the hands-on and written tests. Their EL scores were also higher. Examinees trained to perform aviation radio repair (5937) performed about the same on the hands-on test (114.0 versus 112.0 for those in specialty 2841), but lower on the written test (48.1 versus 56.1). Their EL score was also lower (64.5 versus 71.1, equivalent to standard scores of 113 and 118). Deleting examinees in specialty codes 2845 and 5937 resulted in a sample more homogeneous in terms of training and experience; the ASVAB validity coefficients for the sample restricted to examinees in specialty 2841 can be interpreted with greater confidence that they do, in fact, predict job performance rather than being a function of different training programs.

TABLE B-1

TEST SCORES SHOWN BY SKILL--GROUND RADIO REPAIR

	Skill[a]					
	Mean score			Standard deviation		
Variable	2841	5937	2845	2841	5937	2845
Hands-on test	112.0	114.0	84.6	25.7	18.5	35.6
Written test	56.1	48.1	33.1	11.6	9.8	14.6
Electronics Repair (EL)[b] Aptitude	71.1	64.5	62.1	8.8	8.3	11.7
Number of cases	129	10	19			

[a]Skill:
2841--Ground Radio Repairer, support level
5937--Aviation Radio Repairer
2845--Ground Organizational Level Repairer.
[b]Electronics Repair Aptitude Composite reported as raw scores.

In table B-2, we show test scores for the Ground Radio Repair skill (specialty 2841 only), when the number of cases has been reduced because of missing data. We report the means and standard deviations for the hands-on and written proficiency test, job experience, enlisted grade, and ASVAB AFQT and EL scores. We also show the intercorrelation among these scores.

Automotive Mechanic

All examinees in the Automotive Mechanic sample received the same job training and had duty assignments as mechanics. In table B-3, we

TABLE B-2

EFFECTS OF DELETING CASES--GROUND RADIO REPAIR

Part A: Mean and Standard deviation

	Subgroup					
	Total sample		ASVAB scores available		Final sample	
Variable	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
1 Hands-on test	110.8	25.7	112.0	25.7	113.2	25.5
2 Written test	55.3	11.7	56.1	11.6	53.7	10.5
3 Job experience	33.1	26.9	29.6	24.0	23.2	19.9
4 Enlisted grade	3.9	0.9	3.8	0.8	3.6	0.6
5 AFQT	Not available		58.5	6.6	58.7	6.6
6 Electronics Repair	Not available		71.1	8.8	69.1	9.1
Number of cases	154		129		59	

Part B: Intercorrelation

	Total sample				ASVAB scores available						Final sample					
Variable	1	2	3	4	1	2	3	4	5	6	1	2	3	4	5	6
1 Hands-on test	1.0	0.13	0.14	0.06	1.0	0.07	0.18	0.14	0.19	0.01	1.0	0.09	0.12	-0.10	0.49	0.13
2 Written test	0.13	1.0	0.25	0.22	0.07	1.0	0.35	0.34	0.26	0.47	0.09	1.0	0.18	0.28	0.29	0.34
3 Job experience	0.14	0.25	1.0	0.48	0.18	0.35	1.0	0.44	0.08	0.21	0.12	0.18	1.0	0.51	0.08	0.21
4 Enlisted grade	0.06	0.22	0.48	1.0	0.14	0.34	0.44	1.0	0.15	0.12	-0.10	0.28	0.51	1.0	0.09	0.06
5 AFQT	Not available				0.19	0.26	0.08	0.15	1.0	0.57	0.49	0.29	0.08	0.09	1.0	0.62
6 Electronics Repair	Not available				0.01	0.47	0.21	0.12	0.57	1.0	0.13	0.34	0.21	0.06	0.62	1.0

TABLE B-3

EFFECTS OF DELETING CASES--AUTOMOTIVE MECHANIC

Part A: Mean and Standard Deviation

Variable	Total sample: Mean	Total sample: Standard deviation	ASVAB scores available: Mean	ASVAB scores available: Standard deviation	Final sample: Mean	Final sample: Standard deviation
1 Hands-on test	72.1	7.7	72.3	6.4	72.3	6.4
2 Written test	33.4	7.4	33.8	7.4	33.8	7.5
3 Job experience	26.4	21.6	26.0	21.7	27.3	22.8
4 Enlisted grade	3.2	0.9	3.0	0.8	3.1	0.6
5 AFQT	Not available		43.7	7.8	43.5	7.7
6 Mechanical Maintenance	Not available		70.2	15.9	69.5	16.7
Number of cases	263		205		131	

Part B: Intercorrelation

Variable	Total sample: 1	2	3	4	ASVAB scores available: 1	2	3	4	5	6	Final sample: 1	2	3	4	5	6
1 Hands-on test	1.0	0.24	0.10	0.15	1.0	0.29	0.16	0.24	0.10	0.24	1.0	0.27	0.21	0.25	0.09	0.29
2 Written test	0.24	1.0	0.17	0.23	0.29	1.0	0.32	0.22	0.40	0.42	0.27	1.0	0.42	0.26	0.40	0.49
3 Job experience	0.10	0.17	1.0	0.50	0.16	0.32	1.0	0.34	0.11	0.37	0.21	0.42	1.0	0.23	0.15	0.45
4 Enlisted grade	0.15	0.23	0.50	1.0	0.24	0.22	0.34	1.0	0.16	0.21	0.25	0.26	0.23	1.0	0.13	0.20
5 AFQT	Not available				0.10	0.40	0.11	0.16	1.0	0.46	0.09	0.40	0.15	0.13	1.0	0.48
6 Mechanical Maintenance	Not available				0.24	0.42	0.37	0.21	0.46	1.0	0.29	0.49	0.45	0.20	0.48	1.0

show the means and standard deviations for the hands-on and written proficiency tests, job experience, and enlisted grade when the sample has been reduced because of missing data. We also report the ASVAB, AFQT, and Mechanical Maintenance (MM) scores when they are available. The intercorrelations among these variables are also shown in table B-3.

Infantry Rifleman

The scores for the Infantry Rifleman sample are shown separately for examinees tested with forms 6 and 7 of the ASVAB and those tested with forms 8, 9, and 10. The same variables are included as for the previous samples (hands-on and written proficiency tests, job experience, and enlisted grade, and ASVAB, AFQT, and Combat (CO) scores). The means, standard deviations, and intercorrelations are reported in table B-4.

CORRECTION FOR RESTRICTION IN RANGE

All examinees were selected for assignment to these three skills only if they had qualifying ASVAB scores. People with failing ASVAB scores were excluded. Because the intent of this study is to estimate the validity of ASVAB in the full population of potential recruits, the validity coefficients must be corrected for the effects of eliminating those with failing ASVAB scores. The correction in personnel psychology is called "correction for restriction in range." We have used the multivariate model, which considers all ASVAB subtests simultaneously [B-1].

A brief review of the multivariate correction for restriction in range may help clarify what the corrected correlation coefficients mean. The effect of excluding those with failing ASVAB scores is to reduce the values in the variance-covariance matrix of ASVAB subtest scores. Because the selection occurred on the basis of ASVAB scores, they are called the "explicit" selection variables. All variables correlated with the ASVAB also have their variances and covariances reduced. The other variables that are affected because they are correlated with the explicit selection variables (ASVAB) are called "incidental" selection variables. In our study, the performance measures are subject to incidental selection to the extent they are correlated with the ASVAB, and their variance and covariances are reduced accordingly. The correction procedure attempts to restore the population variances and covariances for the complete set of variables--explicit and incidental--just as though there had been no explicit selection on the ASVAB.

The correction procedure requires that we know the population variances and covariances among one set of variables; in this case we know the population values for the ASVAB. The population for forms 6 and 7 of the ASVAB is a sample of applicants for enlistment tested in January and February 1980. For forms 8, 9, and 10 the population is

TABLE B-4

EFFECTS OF DELETING CASES--INFANTRY RIFLEMAN

Part A: Mean and Standard Deviation

Variable	Subgroup: ASVAB 8/9/10 scores: ASVAB Mean	ASVAB Standard deviation	Final course grade Mean	Final course grade Standard deviation	ASVAB 6/7 scores: ASVAB Mean	ASVAB Standard deviation
1 Hands-on test	50.0	10.0	51.2	10.1	49.6	9.8
2 Written test	50.0	10.0	52.3	9.8	49.5	9.3
3 Job experience	6.9	2.6	7.1	2.2	15.9	4.9
4 Enlisted grade	1.5	0.5	1.6	0.6	2.5	0.7
5 AFQT	53.5	20.3	56.4	21.5	42.0	7.8
6 Combat	100.8	16.0	101.3	16.8	69.3	10.6
Number of cases	142		67		148	

Part B: Intercorrelation

Variable	ASVAB 8/9/10 scores available: 1	2	3	4	5	6	Course grade available: 1	2	3	4	5	6	ASVAB 6/7 scores available: 1	2	3	4	5	6
1 Hands-on test	1.0	.46	-.13	.05	.34	.39	1.0	.43	-.13	.21	.39	.32	1.0	.44	.03	.08	.42	.33
2 Written test	.46	1.0	-.17	.08	.51	.43	.43	1.0	-.27	.13	.56	.43	.44	1.0	.15	.21	.49	.34
3 Job experience	-.13	-.17	1.0	.11	-.17	.02	-.13	-.27	1.0	-.08	-.13	-.07	.03	.15	1.0	.28	.05	-.02
4 Enlisted grade	.05	.08	.11	1.0	.11	.02	.21	.13	-.08	1.0	.23	.13	.08	.21	.28	1.0	-.06	-.08
5 AFQT	.34	.51	-.17	.11	1.0	.64	.39	.56	-.13	.23	1.0	.67	.42	.49	.05	-.06	1.0	.53
6 Combat	.39	.43	.02	.02	.64	1.0	.32	.43	-.07	.13	.67	1.0	.33	.34	-.02	-.08	.53	1.0

based on the nationally representative sample of youth used to construct a new ASVAB score scale [B-2].

Three assumptions are required to use the multivariate correction procedure:

- The regression of the incidental variables on the explicit variables is identical in both selected and unselected (full range) groups.
- The standard errors of estimate for predicting the incidental variables are the same in both groups.
- The correlations among the incidental variables with the explicit variables partialled out are the same in both groups.

What these assumptions require is that the score distributions be affected only by truncation of the explicit variables at the point of selection. The correction then extends the multivariate regression line to cover the full range of scores. If the assumptions are met, then the correction is exact. In practice, of course, selection is rarely, if ever, based solely on test scores, and the correction, therefore, is an approximation. The correction procedure works reasonably well for military samples, and the corrected validity coefficients are closer to the population values than those based on selected samples.

In table B-5 we present the population correlation matrices and standard deviations for the ASVAB subtests obtained at AFEES. We show the corrected validity coefficients of the ASVAB aptitude composites, using test scores obtained at Recruit Training Depots. In appendix C we present the complete correlation matrices for ASVAB scores obtained at AFEES (Armed Forces Examining and Entrance Stations*) and at the Depots.

In table B-6 we show the uncorrected and corrected validity coefficients and standard deviations for the final Ground Radio Repair sample (59 cases). In table B-7 we show the same data for the final Automotive Mechanic sample (131 cases). In table B-8 we show the results for the final sample of Infantry Rifleman. Part A includes those tested with forms 8, 9, and 10 of the ASVAB (53 cases). Part B includes those tested with forms 6 and 7 of the ASVAB (140 cases); no training grades are included for those tested with forms 6 and 7 of the ASVAB. Part C includes the combined sample of Infantry Rifleman (241 cases); we combined cases tested with forms 6, 7, 8, 9, and 10 of the ASVAB, and used only those ASVAB subtests that had parallel content

*AFEES are now called Military Entrance Processing Stations.

across the forms. For the combined sample, we used the 1980 Youth Population as the base matrix for making the correction.

TABLE B-5

POPULATION CORRELATION MATRICES AND STANDARD DEVIATION OF ASVAB SUBTESTS

	GI	NO	AD	WK	AR	SP	MK	EI	MC	GS	SI	AI	Standard deviation
General Information	1.0000	.4918	.1955	.7279	.6079	.4461	.5570	.6569	.5976	.6636	.6139	.5958	3.2000
Numerical Operations	.4918	1.0000	.4239	.4951	.6305	.4167	.6327	.4524	.4761	.4898	.4262	.3970	10.5000
Attention to Detail	.1955	.4239	1.0000	.1859	.2911	.2854	.2702	.1958	.2291	.1857	.2088	.1418	4.0000
Word Knowledge	.7279	.4951	.1859	1.0000	.7252	.5038	.6575	.7203	.6640	.7947	.6420	.5935	7.0000
Arithmetic Reasoning	.6079	.6305	.2911	.7252	1.0000	.5746	.7810	.6345	.6900	.6933	.5688	.5492	4.7000
Space Perception	.4461	.4167	.2854	.5038	.5746	1.0000	.5151	.5344	.6197	.4999	.5128	.4614	4.2000
Mathematics Knowledge	.5570	.6327	.2702	.6575	.7810	.5151	1.0000	.5920	.6245	.6722	.4724	.4644	4.9000
Electronics Information	.6569	.4524	.1958	.7203	.6345	.5344	.5920	1.0000	.7065	.6993	.7082	.7117	5.7000
Mechanical Comprehension	.5976	.4761	.2291	.6640	.6900	.6197	.6245	.7065	1.0000	.6994	.6714	.6694	4.5000
General Science	.6636	.4898	.1857	.7947	.6933	.4999	.6722	.6993	.6994	1.0000	.6423	.6057	4.3000
Shop Information	.6139	.4262	.2088	.6420	.5688	.5128	.4724	.7082	.6714	.6423	1.0000	.7330	4.2000
Automotive Information	.5958	.3970	.1418	.5935	.5492	.4614	.4654	.7117	.6694	.6057	.7330	1.0000	4.8000

TABLE B-6

ASVAB VALIDITY COEFFICIENTS[a]--GROUND RADIO REPAIR[b]

Part A: Uncorrected Coefficients

ASVAB score	Criterion variable: Hands-on test	Written test	Total test	Training grade
Subtest[c]				
General Information	12	21	22	22
Numerical Operations	03	22	16	26
Attention to Detail	18	12	20	05
Word Knowledge	31	38	46	19
Arithmetic Reasoning	40	22	42	38
Space Perception	44	-05	28	10
Mathematics Knowledge	32	24	37	27
Electronics Information	19	26	30	23
Mechanical Comprehension	27	20	31	17
General Science	23	43	43	10
Shop Information	07	23	20	07
Automotive Information	33	11	30	29
Mechanical Interest	-10	09	-01	05
Attentiveness Interest	05	28	21	10
Electronics Interest	-15	11	-03	-06
Combat Interest	-05	-16	-14	-17
Aptitude Composite[d]				
Clerical	32	25	38	23
Combat	30	07	25	16
Electronics Repair	21	34	36	43
Field Artillery	25	29	36	35
General Maintenance	25	24	32	26
General Technical	36	33	46	30
Mechanical Maintenance	17	20	25	35

TABLE B-6 (Cont'd)

Part B: Corrected Coefficients

ASVAB score	Criterion variable: Hands-on test	Written test	Total test	Training grade
Subtest[c]				
General Information	47	61	62	60
Numerical Operations	41	57	56	60
Attention to Detail	36	26	36	22
Word Knowledge	65	71	78	56
Arithmetic Reasoning	68	68	78	71
Space Perception	66	35	59	44
Mathematics Knowledge	62	67	74	68
Electronics Information	58	67	71	65
Mechanical Comprehension	53	62	66	56
General Science	60	73	76	50
Shop Information	43	62	60	46
Automotive Information	53	47	57	53
Mechanical Interest	-17	08	-06	10
Attentiveness Interest	28	22	29	19
Electronics Interest	-01	16	09	12
Combat Interest	25	17	25	12
Aptitude Composite[d]				
Clerical	62	61	71	57
Combat	59	52	64	57
Electronics Repair	59	73	76	75
Field Artillery	62	70	76	72
General Maintenance	62	69	75	65
General Technical	68	69	79	62
Mechanical Maintenance	50	62	64	69

[a]Decimals omitted.
[b]Number of cases is 59.
[c]Tests given at AFEES.
[d]Tests given at depots.

TABLE B-7

ASVAB VALIDITY COEFFICIENTS[a]--AUTOMOTIVE MECHANIC[b]

Part A: Uncorrected Coefficients

ASVAB score	Criterion variable: Hands-on test	Written test	Total test	Training grade
Subtest[c]				
General Information	30	28	35	47
Numerical Operation	09	08	10	19
Attention to Detail	09	01	06	08
Word Knowledge	15	35	31	37
Arithmetic Reasoning	11	19	18	37
Space Perception	13	20	20	08
Mathematics Knowledge	10	15	15	31
Electronics Information	30	35	39	59
Mechanical Comprehension	33	34	40	52
General Science	12	33	27	44
Shop Information	40	27	40	54
Automotive Information	50	41	55	61
Mechanical Interest	31	23	33	40
Attentiveness Interest	-14	-18	-20	-13
Electronics Interest	01	-09	-05	-04
Combat Interest	-08	00	-05	17
Aptitude Composite[d]				
Clerical	23	23	28	46
Combat	32	34	40	47
Electronics Repair	33	44	47	68
Field Artillery	30	37	41	64
General Maintenance	45	50	57	73
General Technical	23	32	34	58
Mechanical Maintenance	49	49	60	73

TABLE B-7 (Cont'd)

Part B: Corrected Coefficients

ASVAB score	Criterion variable: Hands-on test	Written test	Total test	Training grade
Subtest[c]				
General Information	38	47	50	63
Numerical Operations	28	35	37	47
Attention to Detail	13	16	17	20
Word Knowledge	37	58	57	69
Arithmetic Reasoning	34	50	50	66
Space Perception	32	45	45	49
Mathematics Knowledge	32	47	47	65
Electronics Information	45	57	60	77
Mechanical Comprehension	45	55	59	71
General Science	36	57	55	69
Shop Information	49	46	56	68
Automotive Information	57	55	65	71
Mechanical Interest	21	13	19	24
Attentiveness Interest	19	11	17	23
Electronics Interest	22	11	19	24
Combat Interest	01	14	09	25
Aptitude Composite[d]				
Clerical	39	48	51	66
Combat	42	54	57	65
Electronics Repair	47	63	65	82
Field Artillery	45	59	62	80
General Maintenance	54	66	71	84
General Technical	39	55	55	75
Mechanical Maintenance	56	65	71	83

[a]Decimals omitted.
[b]Number of cases is 131.
[c]Tests given at AFEES.
[d]Tests given at Depots.

TABLE B-8

ASVAB VALIDITY COEFFICIENTS[a]--INFANTRY RIFLEMAN

Part A: Examinees tested with ASVAB 8/9/10[b], Uncorrected Coefficients

	Criterion variable			
ASVAB score	Hands-on test	Written test	Total test	Training grade
Subtest[c]				
General Science	41	56	57	22
Arithmetic Reasoning	26	44	41	25
Word Knowledge	38	63	59	31
Paragraph Comprehension	48	43	53	21
Numerical Operations	14	22	21	-03
Coding Speed	13	30	25	08
Auto/Shop	42	28	41	13
Mathematics Knowledge	45	51	56	31
Mechanical Comprehension	50	40	53	30
Electronics Information	44	47	54	29
Aptitude Composite[d]				
Clerical	20	31	30	-04
Combat	40	48	52	13
Electronics Repair	41	53	55	18
Field Artillery	43	54	57	22
General Maintenance	42	48	53	15
General Technical	37	55	54	21
Mechanical Maintenance	43	43	50	16

TABLE B-8 (Cont'd)

Part A: Examinees Tested with ASVAB 8/9/10[b], Corrected Coefficients

ASVAB score	Criterion variable			
	Hands-on test	Written test	Total test	Training grade
Subtest[c]				
General Science	55	72	72	37
Arithmetic Reasoning	44	66	63	46
Word Knowledge	52	81	76	46
Paragraph Comprehension	61	68	73	35
Numerical Operations	50	59	62	23
Coding Speed	40	57	55	19
Auto/Shop	45	38	46	26
Mathematics Knowledge	53	65	67	43
Mechanical Comprehension	57	52	61	38
Electronics Information	52	66	67	45
Aptitude Composite[d]				
Clerical	41	51	52	08
Combat	58	69	72	29
Electronics Repair	56	74	74	38
Field Artillery	57	74	74	40
General Maintenance	56	68	70	32
General Technical	53	77	74	41
Mechanical Maintenance	53	60	64	32

TABLE B-8 (Cont'd)

Part B: Examinees Tested with ASVAB 6/7[e]

ASVAB score	Criterion variable					
	Uncorrected			Corrected		
	Hands-on test	Written test	Total test	Hands-on test	Written test	Total test
Subtest						
General Information	26	45	41	50	65	64
Numerical Operations	07	26	19	38	53	50
Attention to Detail	01	-02	00	16	14	17
Word Knowledge	32	38	41	58	68	70
Arithmetic Reasoning	28	32	36	58	66	69
Space Perception	22	23	27	47	50	54
Mathematics Knowledge	32	45	45	55	65	67
Electronics Information	30	31	36	54	59	63
Mechanical Comprehension	40	34	44	60	60	67
General Science	37	43	47	59	68	71
Shop Information	31	39	41	48	59	59
Automotive Information	25	32	33	47	54	56
Mechanical Interest	06	00	03	14	07	12
Attentiveness Interest	-07	05	-02	18	29	26
Electronics Interest	07	05	08	24	23	26
Combat Interest	22	24	27	30	33	35
Aptitude Composite						
Clerical	24	39	37	53	65	66
Combat	31	28	35	53	54	59
Electronics Repair	41	52	55	62	72	75
Field Artillery	38	52	53	61	72	74
General Maintenance	47	51	58	66	71	76
General Technical	43	58	59	64	77	78
Mechanical Maintenance	41	37	46	60	60	67

TABLE B-8 (Cont'd)

Part C: Pooled Groups[g]

ASVAB score	Criterion variable: Uncorrected, Hands-on test	Uncorrected, Written test	Uncorrected, Total test	Corrected, Hands-on test	Corrected, Written test	Corrected, Total test
General Science	37	49	50	50	67	66
Arithmetic Reasoning	25	37	36	45	61	60
Word Knowledge	32	48	47	46	67	64
Numerical Operations	09	23	18	29	49	44
Auto/Shop	36	41	45	47	52	56
Mathematics Knowledge	32	44	44	45	61	60
Mechanical Comprehension	41	37	46	52	55	60
Electronics Information	43	41	43	48	60	62
Combat Aptitude	37	52	51	51	69	68

[a]Decimals omitted.
[b]Number of cases is 53.
[c]Tests given at AFEES.
[d]Tests given at Depots.
[e]Number of cases is 140.
[f]No training grades available for this group.
[g]Number of cases is 241, tested with forms 6, 7, 8, 9, and 10.

REFERENCES

[B-1] Gulliksen, Harold. Theory of Mental Tests. New York: Wiley, 1950

[B-2] CNA, Memorandum 82-3118, "Constructing an ASVAB Score Scale in the 1980 Reference Population," by Milton H. Maier and William H. Sims, Unclassified, 3 Aug 1982

APPENDIX C

DETAILED STATISTICAL TABLES

APPENDIX C

DETAILED STATISTICAL TABLES

In this appendix we present a complete set of intercorrelation matrices. In tables C-1, C-2, and C-3 we show the intercorrelation among the parts of the hands-on and written proficiency tests for the Ground Radio Repair, Automotive Mechanic, and Infantry Rifleman skills, respectively. All examinees in each skill were included when computing these intercorrelation matrices. The Ground Radio Repair sample includes only examinees with specialty number 2841. (See appendix B for a description of this specialty number.) The variables are described for each table.

In tables C-4 and C-5, we present the uncorrected and corrected intercorrelation matrices for the final Ground Radio Repair and Automotive Mechanic samples, respectively. (See appendix B for a description of the procedure to correct correlation coefficients for restriction in range.) Part A of each table contains the uncorrected coefficients, and part B the corrected coefficients. In tables C-6, C-7, and C-8 we present the uncorrected and corrected intercorrelation matrices for the Infantry Rifleman samples. Table C-6 contains results for examinees tested with forms 6 and 7 of the ASVAB at time of enlistment; table C-7 is for examinees tested with forms 8, 9, and 10 of the ASVAB. Table C-8 contains the uncorrected and corrected intercorrelation matrices for the combined sample of riflemen, using the ASVAB subtests that are common to forms 6, 7, 8, 9, and 10.

TABLE C-1

INTERCORRELATION AMONG PARTS OF HANDS-ON
AND WRITTEN PROFICIENCY TESTS

GROUND RADIO REPAIR

Part A: Hands-on Test

VARIABLE	MEAN	STANDARD DEV	CASES
BOARD1	12.3636	3.1391	154
BOARD2	12.2338	3.5199	154
BOARD3	10.3571	4.3064	154
BOARD4	11.1688	4.4557	154
BOARD5	11.7013	3.5482	154
BOARD6	10.6948	3.7422	154
BOARD7	11.3377	4.2105	154
BOARD8	9.5844	5.2427	154
BOARD9	11.5065	4.5060	154
BOARD10	9.8312	5.3636	154
SYMSC	18.7078	1.7930	154
CIRSC	35.8766	5.4836	154
COMPSC	56.1948	20.4572	154
SYM1	1.8312	0.5578	154
SYM2	1.8701	0.4944	154
SYM3	1.8571	0.5168	154
SYM4	1.8052	0.5949	154
SYM5	1.9740	0.2272	154
SYM6	2.0000	0.0000	154
SYM7	1.9091	0.4180	154
SYM8	1.9091	0.4180	154
SYM9	1.8701	0.4944	154
SYM10	1.6818	0.7294	154
CIR1	3.9091	0.5758	154
CIR2	3.7662	0.8841	154
CIR3	3.5390	1.1999	154
CIR4	3.4026	1.3745	154
CIR5	3.8961	0.5503	154
CIR6	3.9286	0.4865	154
CIR7	3.6364	1.1537	154
CIR8	2.9870	1.6996	154
CIR9	3.5714	1.2306	154
CIR10	3.2403	1.5679	154
COMP1	6.6234	2.8699	154
COMP2	6.5974	2.8480	154
COMP3	4.9610	3.4846	154
COMP4	5.9610	3.3174	154
COMP5	5.8312	3.3758	154
COMP6	4.7662	3.6314	154
COMP7	5.7922	3.4540	154
COMP8	4.6883	3.8083	154
COMP9	6.0649	3.3794	154
COMP10	4.9091	3.7857	154
SCORE	110.7792	25.7345	154

TABLE C-1 (Cont'd)

Part A: Hands-on Test

Variable	Description
BOARD 1	Symptom plus circuit plus component score for BOARD 1
BOARD 2	Symptom plus circuit plus component score for BOARD 2
BOARD 3	Symptom plus circuit plus component score for BOARD 3
BOARD 4	Symptom plus circuit plus component score for BOARD 4
BOARD 5	Symptom plus circuit plus component score for BOARD 5
BOARD 6	Symptom plus circuit plus component score for BOARD 6
BOARD 7	Symptom plus circuit plus component score for BOARD 7
BOARD 8	Symptom plus circuit plus component score for BOARD 8
BOARD 9	Symptom plus circuit plus component score for BOARD 9
BOARD 10	Symptom plus circuit plus component score for BOARD 10
SYMSC	Symptom score, sum of BOARDs 1 through 10
CIRSC	Circuit score, sum of BOARDs 1 through 10
COMPSC	Component score, sum of BOARDs 1 through 10
SYM1	Identify faulty symptom, BOARD 1
SYM2	Identify faulty symptom, BOARD 2
SYM3	Identify faulty symptom, BOARD 3
SYM4	Identify faulty symptom, BOARD 4
SYM5	Identify faulty symptom, BOARD 5
SYM6	Identify faulty symptom, BOARD 6
SYM7	Identify faulty symptom, BOARD 7
SYM8	Identify faulty symptom, BOARD 8
SYM9	Identify faulty symptom, BOARD 9
SYM10	Identify faulty symptom, BOARD 10
CIR1	Identify faulty circuit, BOARD 1
CIR2	Identify faulty circuit, BOARD 2
CIR3	Identify faulty circuit, BOARD 3
CIR4	Identify faulty circuit, BOARD 4
CIR5	Identify faulty circuit, BOARD 5
CIR6	Identify faulty circuit, BOARD 6
CIR7	Identify faulty circuit, BOARD 7
CIR8	Identify faulty circuit, BOARD 8
CIR9	Identify faulty circuit, BOARD 9
CIR10	Identify faulty circuit, BOARD 10
COMP1	Identify faulty component, BOARD 1
COMP2	Identify faulty component, BOARD 2
COMP3	Identify faulty component, BOARD 3
COMP4	Identify faulty component, BOARD 4
COMP5	Identify faulty component, BOARD 5
COMP6	Identify faulty component, BOARD 6
COMP7	Identify faulty component, BOARD 7
COMP8	Identify faulty component, BOARD 8
COMP9	Identify faulty component, BOARD 9
COMP10	Identify faulty component, BOARD 10
SCORE	Sum of BOARD 1 through 10

TABLE C-1 (Cont'd)

	BOARD1	BOARD2	BOARD3	BOARD4	BOARD5	BOARD6	BOARD7	BOARD8	BOARD9	BOARD10	SYMSC	CIRSC
BOARD1	1.00000	0.42526	0.32975	0.21053	0.09901	0.09297	0.19636	0.21417	0.31589	0.30801	0.23500	0.39827
BOARD2	0.42526	1.00000	0.41789	0.34919	0.09355	0.24660	0.16046	0.23339	0.33864	0.32614	0.22424	0.50335
BOARD3	0.32975	0.41789	1.00000	0.34598	0.40141	0.30085	0.16669	0.37601	0.33587	0.37388	0.28194	0.55073
BOARD4	0.21053	0.34919	0.34598	1.00000	0.33642	0.31003	0.23105	0.32198	0.38570	0.40759	0.38991	0.65864
BOARD5	0.09901	0.09355	0.40141	0.33642	1.00000	0.24708	0.25266	0.35588	0.35210	0.36824	0.20399	0.43815
BOARD6	0.09297	0.24660	0.30085	0.31003	0.24708	1.00000	0.15799	0.24668	0.16853	0.15176	0.14248	0.27716
BOARD7	0.19636	0.16046	0.16669	0.23105	0.25266	0.15799	1.00000	0.39249	0.16593	0.29600	0.17505	0.36841
BOARD8	0.21417	0.23339	0.37601	0.32198	0.35588	0.24668	0.39249	1.00000	0.32437	0.46049	0.36525	0.59294
BOARD9	0.31589	0.33864	0.33587	0.38570	0.35210	0.16853	0.16593	0.32437	1.00000	0.54226	0.48847	0.64929
BOARD10	0.30801	0.32614	0.37388	0.40759	0.36824	0.15176	0.29600	0.46049	0.54226	1.00000	0.39378	0.66528
SYMSC	0.23500	0.22424	0.28194	0.38991	0.20399	0.14248	0.17505	0.36525	0.48847	0.39378	1.00000	0.53810
CIRSC	0.39827	0.50335	0.55073	0.65864	0.43815	0.27716	0.36841	0.59294	0.64929	0.66528	0.53810	1.00000
COMPSC	0.49435	0.56104	0.66336	0.60926	0.58969	0.49920	0.52235	0.66745	0.61622	0.71021	0.38895	0.76382
SYM1	0.13980	0.04686	-0.11622	-0.03579	-0.10490	-0.04363	0.01886	0.03843	-0.06457	-0.10570	0.38165	-0.00685
SYM2	0.04747	0.28796	0.24294	0.16429	0.09696	0.17625	-0.06671	0.26144	0.12360	0.10998	0.31081	0.22548
SYM3	0.12893	0.13347	0.35202	0.26601	0.17619	0.05166	0.14848	0.05514	0.13794	0.12329	0.42023	0.23362
SYM4	0.03818	-0.00308	-0.04410	0.13576	0.00941	0.01422	0.02121	-0.04289	0.10043	0.01420	0.39970	0.06471
SYM5	-0.02333	-0.05775	0.00954	-0.07312	0.08761	0.02137	0.11856	0.01283	-0.06368	-0.00362	0.23799	-0.02358
SYM6	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
SYM7	-0.09420	-0.10586	-0.06900	-0.05488	-0.03606	0.04065	0.11412	0.00651	-0.03786	-0.08853	0.22597	-0.03915
SYM8	-0.01449	-0.05654	-0.12710	0.02935	0.01683	0.00722	0.15869	0.24513	0.00379	0.03976	0.33064	0.01789
SYM9	0.04747	0.18280	0.20611	0.21176	0.15657	-0.00743	-0.04159	0.23118	0.53431	0.39094	0.51725	0.45208
SYM10	0.35343	0.21753	0.37348	0.46910	0.26102	0.18687	0.17353	0.38221	0.66380	0.63936	0.58811	0.66987
CIR1	0.49572	0.04925	0.17133	0.06207	0.05060	-0.14036	-0.01421	0.07401	0.21435	0.23202	0.16403	0.26138
CIR2	0.26634	0.73179	0.30362	0.30874	0.01927	0.16004	-0.06996	0.08607	0.16773	0.15702	0.20402	0.40926
CIR3	0.31204	0.38163	0.65969	0.31173	0.22843	0.11257	0.10217	0.24364	0.40493	0.23360	0.22559	0.61216
CIR4	0.13551	0.39652	0.35872	0.85328	0.26873	0.30487	0.14802	0.32087	0.33622	0.35504	0.40610	0.65269
CIR5	-0.09906	-0.09535	-0.05043	-0.01412	0.37227	0.21300	0.07165	-0.08755	0.00027	-0.05912	-0.00447	0.06503
CIR6	-0.07703	-0.07415	-0.07509	0.07495	0.08600	0.28950	0.00866	-0.01171	-0.08178	-0.00465	-0.10650	0.04812
CIR7	0.15226	0.04682	-0.05262	0.13408	0.13935	0.05890	0.71435	0.16504	0.07589	0.17591	0.17580	0.29454
CIR8	0.20180	0.24961	0.38551	0.34379	0.30065	0.15660	0.27827	0.84438	0.28250	0.36541	0.27971	0.63729
CIR9	0.18273	0.22245	0.27573	0.32080	0.23992	0.12185	0.07100	0.22344	0.81024	0.42069	0.48198	0.61972
CIR10	0.28757	0.26689	0.32118	0.37868	0.31845	0.10392	0.21435	0.35254	0.52017	0.82947	0.40179	0.69830
COMP1	0.96716	0.44616	0.34889	0.22479	0.11853	0.13833	0.21397	0.21194	0.31507	0.31090	0.14995	0.38452
COMP2	0.43465	0.95874	0.38004	0.30720	0.09280	0.22449	0.23161	0.21634	0.34500	0.33524	0.15984	0.45590
COMP3	0.28095	0.36524	0.95786	0.28078	0.39129	0.32538	0.14880	0.37262	0.25519	0.36334	0.20844	0.43518
COMP4	0.21979	0.30528	0.32398	0.96527	0.33883	0.28755	0.24521	0.30722	0.36074	0.39781	0.28378	0.60263
COMP5	0.12179	0.11775	0.42949	0.36082	0.98449	0.22354	0.24591	0.38746	0.37432	0.39692	0.19912	0.45151
COMP6	0.10613	0.26407	0.32009	0.30945	0.24310	0.99174	0.16165	0.25578	0.18463	0.15702	0.16110	0.27918
COMP7	0.19991	0.19325	0.22912	0.24351	0.26582	0.16799	0.96660	0.42254	0.18150	0.31279	0.12733	0.35545
COMP8	0.20636	0.21611	0.35953	0.28661	0.35389	0.26890	0.39872	0.97290	0.32005	0.46649	0.34169	0.52989
COMP9	0.34771	0.34378	0.31726	0.36648	0.35919	0.18143	0.20148	0.31731	0.96013	0.51264	0.40011	0.57392
COMP10	0.24920	0.30964	0.32474	0.33027	0.33954	0.13597	0.29717	0.43277	0.42495	0.95009	0.27820	0.52430
SCORE	0.49421	0.56887	0.66432	0.65183	0.57634	0.46582	0.50593	0.68237	0.66224	0.73377	0.49352	0.85776

TABLE C-1 (Cont'd)

	COMPSC	SYM1	SYM2	SYM3	SYM4	SYM5	SYM6	SYM7	SYM8	SYM9	SYM10	CIR1
BOARD1	0.49435	0.13980	0.04747	0.12893	0.03818	-0.02333	99.00000	-0.09420	-0.01449	0.04747	0.35343	0.49572
BOARD2	0.56104	0.04686	0.28796	0.13347	-0.00308	-0.05775	99.00000	-0.10986	-0.05654	0.18280	0.21753	0.04925
BOARD3	0.66336	-0.11622	0.24294	0.35202	-0.04410	0.00554	99.00000	-0.06900	-0.12710	0.20611	0.37348	0.17133
BOARD4	0.60926	-0.03579	0.16429	0.26601	0.13576	-0.07312	99.00000	-0.05488	0.02935	0.21176	0.46910	0.06207
BOARD5	0.58969	-0.10490	0.09696	0.17619	0.00941	0.08761	99.00000	-0.03606	0.01683	0.15657	0.26102	0.05060
BOARD6	0.49920	-0.04363	0.17625	0.05166	0.01422	0.02137	99.00000	0.04065	0.00722	-0.00743	0.18687	-0.14036
BOARD7	0.52235	0.01886	-0.06671	0.14848	0.02121	0.11856	99.00000	0.11412	0.15869	-0.04159	0.17353	-0.01421
BOARD8	0.66745	0.03843	0.26144	0.05514	-0.04289	0.01283	99.00000	0.00651	0.24513	0.23118	0.38221	0.07401
BOARD9	0.61622	-0.06457	0.12360	0.13794	0.10043	-0.06368	99.00000	-0.03786	0.00379	0.53431	0.66380	0.21435
BOARD10	0.71021	-0.10570	0.10998	0.12329	0.01420	-0.00362	99.00000	-0.08853	0.03976	0.39094	0.63936	0.23202
SYMSC	0.38895	0.38165	0.31081	0.42023	0.39970	0.23799	99.00000	0.22597	0.33064	0.51725	0.58811	0.16403
CIRSC	0.76382	-0.00685	0.22948	0.23362	0.06471	-0.02358	99.00000	-0.03915	0.01789	0.45208	0.66987	0.26138
COMPSC	1.00000	-0.08874	0.21447	0.22275	-0.00331	-0.01016	99.00000	-0.07436	0.04489	0.25841	0.56832	0.15688
SYM1	-0.08874	1.00000	0.01477	0.00648	0.13658	0.17147	99.00000	0.04587	0.04587	0.01477	-0.06863	0.03330
SYM2	0.21447	0.01477	1.00000	0.02924	0.00231	-0.03023	99.00000	-0.05751	0.06901	0.03750	0.02965	-0.04174
SYM3	0.22275	0.00648	0.02924	1.00000	0.07896	-0.03181	99.00000	0.06052	-0.06052	0.13156	0.15605	0.13179
SYM4	-0.00331	0.13658	0.00231	0.07896	1.00000	-0.03768	99.00000	-0.07169	0.03345	0.00231	0.03697	-0.05203
SYM5	-0.01016	0.17147	-0.03023	-0.03181	-0.03768	1.00000	99.00000	0.25031	0.25031	-0.03023	-0.05020	-0.01817
SYM6	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	1.00000	99.00000	99.00000	99.00000	99.00000	99.00000
SYM7	-0.07436	0.04587	-0.05751	0.06052	-0.07169	0.25031	99.00000	1.00000	-0.04762	-0.05751	-0.00974	-0.03457
SYM8	0.04489	0.04587	0.06901	-0.06052	0.03345	0.25031	99.00000	-0.04762	1.00000	0.06901	0.07601	-0.03457
SYM9	0.25841	0.01477	0.03750	0.13156	0.00231	-0.03023	99.00000	-0.05751	0.06901	1.00000	0.46459	0.14192
SYM10	0.56832	-0.06863	0.02965	0.15605	0.03697	-0.05020	99.00000	-0.00974	0.07601	0.46459	1.00000	0.30415
CIR1	0.15688	0.03330	-0.04174	0.13179	-0.05203	-0.01817	99.00000	-0.03457	-0.03457	0.14192	0.30415	1.00000
CIR2	0.28875	0.07848	0.28895	0.09810	0.01226	-0.03043	99.00000	-0.05789	-0.05789	0.16933	0.12715	-0.04202
CIR3	0.42973	-0.07799	0.16283	0.18824	-0.01677	-0.04422	99.00000	-0.08412	-0.08412	0.25097	0.32417	0.27951
CIR4	0.52206	0.00399	0.23132	0.28395	0.04858	-0.05002	99.00000	-0.00414	0.04137	0.23132	0.43500	-0.06907
CIR5	0.01806	-0.05751	-0.04991	0.03940	0.09748	0.18739	99.00000	0.07233	-0.04133	-0.04991	-0.08289	-0.03000
CIR6	0.01979	-0.04473	-0.03882	-0.04085	-0.04839	-0.01690	99.00000	-0.03214	-0.03214	-0.03882	-0.06446	-0.02333
CIR7	0.24229	0.06648	-0.08333	0.08771	0.12466	0.18323	99.00000	0.03943	0.14787	0.00833	0.11015	-0.05009
CIR8	0.54709	0.06661	0.18464	0.07229	-0.04130	-0.06859	99.00000	0.01673	0.05353	0.21576	0.32877	0.11900
CIR9	0.41042	-0.02992	0.16573	0.06754	0.09947	-0.04008	99.00000	0.02541	-0.07624	0.59540	0.60432	0.09224
CIR10	0.55850	-0.08783	0.07424	0.12331	0.06452	-0.05576	99.00000	-0.10609	0.05350	0.36090	0.66734	0.27050
COMP1	0.52649	-0.04814	0.05743	0.11333	0.02565	-0.05520	99.00000	-0.10502	-0.01783	0.02058	0.33889	0.33511
COMP2	0.56652	0.03699	0.09259	0.12942	-0.00802	-0.05668	99.00000	-0.10782	-0.06389	0.16685	0.22423	0.08116
COMP3	0.63881	-0.11773	0.23984	0.22193	-0.06043	0.03174	99.00000	-0.06528	-0.11913	0.14879	0.32680	0.09595
COMP4	0.60262	-0.07422	0.12441	0.22549	-0.01712	-0.07073	99.00000	-0.05914	0.01628	0.18817	0.44321	0.12131
COMP5	0.61754	-0.11242	0.11208	0.18091	-0.00347	-0.00576	99.00000	-0.06654	0.00758	0.17474	0.29124	0.05930
COMP6	0.51179	-0.03897	0.18684	0.05871	0.02114	0.02428	99.00000	0.04620	0.01174	-0.00246	0.20121	-0.14151
COMP7	0.56482	-0.00476	-0.04652	0.14438	-0.00710	0.05971	99.00000	0.00494	0.14982	-0.04652	0.17593	0.00359
COMP8	0.66975	0.01814	0.26993	0.05029	-0.04428	0.02080	99.00000	0.00672	0.20382	0.21440	0.37110	0.05257
COMP9	0.63437	-0.07736	0.09896	0.14008	0.09735	-0.06590	99.00000	-0.05132	0.02272	0.34930	0.59704	0.23145
COMP10	0.66543	-0.10016	0.11936	0.09355	-0.01372	0.02764	99.00000	-0.07961	0.01953	0.31490	0.43679	0.15810
SCORE	0.98479	-0.04541	0.24019	0.25613	0.03901	0.00348	99.00000	-0.05171	0.06253	0.33778	0.63549	0.19183

TABLE C-1 (Cont'd)

	CIR2	CIR3	CIR4	CIR5	CIR6	CIR7	CIR8	CIR9	CIR10	COMP1	COMP2	COMP3
BOARD1	0.26634	0.31204	0.13551	-0.09906	-0.07703	0.15226	0.20180	0.18273	0.28757	0.96716	0.43465	0.28095
BOARD2	0.73179	0.38163	0.39652	-0.09535	-0.07415	0.04682	0.24961	0.22245	0.26689	0.44616	0.95874	0.36524
BOARD3	0.30362	0.65569	0.35872	-0.05043	-0.07509	-0.05262	0.38551	0.27573	0.32118	0.34889	0.38004	0.95786
BOARD4	0.30874	0.31173	0.85328	-0.01412	0.07495	0.13408	0.34379	0.32080	0.37868	0.22479	0.30720	0.28078
BOARD5	0.01927	0.22843	0.26873	0.37227	0.08600	0.13935	0.30065	0.23992	0.31845	0.11853	0.09280	0.39129
BOARD6	0.16004	0.11257	0.30487	0.21300	0.28950	0.05890	0.15660	0.12185	0.10392	0.13833	0.22449	0.32538
BOARD7	-0.06996	0.10217	0.14802	0.07165	0.00866	0.71435	0.27827	0.07100	0.21435	0.21397	0.23161	0.14880
BOARD8	0.08607	0.24364	0.32087	-0.08755	-0.01171	0.16504	0.84438	0.22344	0.35254	0.21194	0.21634	0.37262
BOARD9	0.16773	0.40493	0.33622	0.00027	-0.08178	0.07589	0.28250	0.81024	0.52017	0.31507	0.34500	0.25519
BOARD10	0.15702	0.23360	0.35604	-0.05912	-0.00465	0.17591	0.36541	0.42069	0.82947	0.31090	0.33524	0.36334
SYMSC	0.20402	0.22559	0.40610	-0.00447	-0.10650	0.17580	0.27971	0.48198	0.40179	0.14995	0.15984	0.20844
CIRSC	0.40926	0.61216	0.65269	0.06503	0.04812	0.29454	0.63729	0.61972	0.69830	0.38452	0.45590	0.43518
COMPSC	0.28875	0.42573	0.52206	0.01806	0.01979	0.24229	0.54709	0.41042	0.55850	0.52649	0.56652	0.63881
SYM1	0.07848	-0.07799	0.00399	-0.05751	-0.04473	0.06648	0.06661	-0.02992	-0.08783	-0.04814	0.03099	-0.11773
SYM2	0.28895	0.16283	0.23132	-0.04991	-0.03882	-0.08333	0.18464	0.16573	0.07424	0.05743	0.09259	0.23984
SYM3	0.09810	0.18824	0.28395	0.03940	-0.04085	0.08771	0.07229	0.06754	0.12331	0.11333	0.12942	0.22193
SYM4	0.01226	-0.01677	0.04858	0.09748	-0.04839	0.12466	-0.04130	0.09947	0.06452	0.02565	-0.00802	-0.06043
SYM5	-0.03043	-0.04422	-0.05002	0.18739	-0.01690	0.16323	-0.06859	-0.04008	-0.05576	-0.05520	-0.05668	0.03174
SYM6	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
SYM7	-0.05789	-0.06412	-0.00414	0.07233	-0.03214	0.03943	0.01673	0.02541	-0.10609	-0.10502	-0.10782	-0.06528
SYM8	-0.05789	-0.08412	0.04137	-0.04133	-0.03214	0.14787	0.05353	-0.07624	0.05350	-0.01783	-0.06389	-0.11913
SYM9	0.16933	0.25097	0.23132	-0.04991	-0.03882	0.00833	0.21576	0.59540	0.36090	0.02058	0.16685	0.14879
SYM10	0.12715	0.32417	0.43500	-0.08289	-0.06446	0.11015	0.32877	0.60432	0.66734	0.33889	0.22423	0.32680
CIR1	-0.04202	0.27951	-0.06907	-0.03000	-0.02333	-0.05009	0.11900	0.09224	0.27050	0.33511	0.08116	0.09595
CIR2	1.00000	0.26743	0.37917	-0.05025	-0.03907	-0.08389	0.10236	0.19567	0.17281	0.28450	0.54384	0.26859
CIR3	0.26743	1.00000	0.32334	-0.07302	-0.05678	-0.02747	0.32075	0.36107	0.27120	0.30039	0.36037	0.43808
CIR4	0.37917	0.32334	1.00000	-0.08259	0.01396	0.05995	0.33240	0.34225	0.32181	0.16131	0.33220	0.28988
CIR5	-0.05025	-0.07302	-0.08259	1.00000	0.36268	0.10482	-0.11326	0.01103	-0.03148	-0.09115	-0.09358	-0.04302
CIR6	-0.03907	-0.05678	0.01396	0.36268	1.00000	-0.04658	-0.05646	-0.05146	-0.07161	-0.07089	-0.07278	-0.06719
CIR7	-0.08389	-0.02747	0.05995	0.10482	-0.04658	1.00000	0.13091	0.03683	0.13534	0.16367	0.09838	-0.06858
CIR8	0.10236	0.32075	0.33240	-0.11326	-0.05646	0.13091	1.00000	0.19106	0.31758	0.18390	0.24466	0.35527
CIR9	0.19567	0.36107	0.34225	0.01103	-0.05146	0.03683	0.19106	1.00000	0.43988	0.18717	0.18541	0.20641
CIR10	0.17281	0.27120	0.32181	-0.03148	-0.07161	0.13534	0.31758	0.43988	1.00000	0.27734	0.26331	0.28525
COMP1	0.28450	0.30039	0.16131	-0.09115	-0.07089	0.16367	0.18390	0.18717	0.27734	1.00000	0.45312	0.31093
COMP2	0.54384	0.36037	0.33220	-0.09358	-0.07278	0.09838	0.24466	0.18541	0.26331	0.45312	1.00000	0.32638
COMP3	0.26859	0.43808	0.28988	-0.04302	-0.06719	-0.06858	0.35527	0.20641	0.28525	0.31093	0.32638	1.00000
COMP4	0.25539	0.28774	0.72305	-0.00223	0.10356	0.13290	0.33144	0.27125	0.36372	0.23049	0.27642	0.26787
COMP5	0.03049	0.25497	0.29929	0.21565	0.03241	0.11839	0.33908	0.25307	0.34360	0.14316	0.11661	0.41615
COMP6	0.17017	0.12361	0.31231	0.17092	0.16436	0.06694	0.16894	0.13246	0.11669	0.15205	0.24110	0.34431
COMP7	-0.05026	0.14390	0.16092	0.04358	0.03000	0.53202	0.29346	0.07117	0.22893	0.21887	0.26252	0.21219
COMP8	0.07916	0.20149	0.28884	-0.06545	0.01260	0.15255	0.71024	0.23070	0.33772	0.21165	0.19565	0.36748
COMP9	0.12762	0.37172	0.28983	0.00365	-0.08462	0.08656	0.27552	0.62908	0.48058	0.34892	0.36808	0.24332
COMP10	0.12640	0.15619	0.28594	-0.05476	0.03549	0.17196	0.32284	0.29742	0.63247	0.26032	0.32272	0.33367
SCORE	0.33096	0.48776	0.58238	0.02791	0.01857	0.26762	0.59019	0.49189	0.62076	0.51091	0.55862	0.61506

TABLE C-1 (Cont'd)

	COMP4	COMP5	COMP6	COMP7	COMP8	COMP9	COMP10	SCORE
BOARD1	0.21979	0.12179	0.10613	0.19991	0.20636	0.34771	0.24920	0.49421
BOARD2	0.30528	0.11775	0.26407	0.19325	0.21611	0.34378	0.30964	0.56887
BOARD3	0.32398	0.42949	0.32009	0.22912	0.35953	0.31726	0.32474	0.66432
BOARD4	0.96527	0.36082	0.30945	0.24351	0.28661	0.36648	0.33027	0.65183
BOARD5	0.33883	0.98449	0.24310	0.26582	0.35389	0.35919	0.33954	0.57634
BOARD6	0.28755	0.22354	0.99174	0.16799	0.26890	0.18143	0.13597	0.46582
BOARD7	0.24521	0.24591	0.16165	0.96660	0.39872	0.20148	0.29717	0.50593
BOARD8	0.30722	0.38746	0.25578	0.42254	0.97290	0.31731	0.43277	0.68237
BOARD9	0.36074	0.37432	0.18463	0.18150	0.32005	0.96013	0.42495	0.66224
BOARD10	0.39781	0.39692	0.15702	0.31279	0.46649	0.51264	0.95009	0.73377
SYMSC	0.28378	0.19912	0.16110	0.12733	0.34169	0.40011	0.27820	0.49352
CIRSC	0.60263	0.45151	0.27918	0.35545	0.52989	0.57392	0.52430	0.85776
COMPSC	0.60262	0.61754	0.51179	0.56482	0.66975	0.63437	0.66543	0.98479
SYM1	-0.07422	-0.11242	-0.03897	-0.00476	0.01814	-0.07736	-0.10016	-0.04541
SYM2	0.12441	0.11208	0.18684	-0.04652	0.26993	0.09896	0.11936	0.24019
SYM3	0.22549	0.18091	0.05871	0.14438	0.05029	0.14008	0.09355	0.25613
SYM4	-0.01712	-0.00347	0.02114	-0.00710	-0.04428	0.09735	-0.01372	0.03901
SYM5	-0.07073	-0.00576	0.02428	0.05971	0.02080	-0.06590	0.02764	0.00348
SYM6	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000	99.00000
SYM7	-0.05914	-0.06654	0.04820	0.00494	0.00672	-0.05132	-0.07961	-0.05171
SYM8	0.01628	0.00758	0.01174	0.14982	0.20382	0.02272	0.01953	0.06253
SYM9	0.18817	0.17474	-0.00246	-0.04652	0.21440	0.34930	0.31490	0.33778
SYM10	0.44321	0.29124	0.20121	0.17593	0.37110	0.59704	0.43679	0.63549
CIR1	0.12131	0.05930	-0.14151	0.00359	0.05257	0.23145	0.15810	0.19183
CIR2	0.25539	0.03049	0.17017	-0.05026	0.07916	0.12762	0.12640	0.33096
CIR3	0.28774	0.25497	0.12361	0.14390	0.20149	0.37172	0.15619	0.48776
CIR4	0.72305	0.29929	0.31231	0.16092	0.28884	0.28983	0.28594	0.58238
CIR5	-0.00223	0.21565	0.17092	0.04358	-0.06545	0.00365	-0.05476	0.02791
CIR6	0.10356	0.03241	0.16436	0.03000	0.01260	-0.08462	0.03549	0.01857
CIR7	0.13290	0.11839	0.06694	0.53202	0.15255	0.08656	0.17196	0.26762
CIR8	0.33144	0.33508	0.16894	0.29346	0.71024	0.27552	0.32284	0.59019
CIR9	0.27125	0.25307	0.13246	0.07117	0.23070	0.62908	0.29742	0.49189
CIR10	0.36372	0.34360	0.11669	0.22893	0.33772	0.48058	0.63247	0.62076
COMP1	0.23049	0.14316	0.15205	0.21887	0.21165	0.34892	0.26032	0.51091
COMP2	0.27642	0.11661	0.24110	0.26252	0.19565	0.36808	0.32272	0.55862
COMP3	0.26787	0.41615	0.34431	0.21219	0.36748	0.24332	0.33367	0.61506
COMP4	1.00000	0.36126	0.28245	0.26168	0.27322	0.35469	0.32759	0.62722
COMP5	0.36126	1.00000	0.22602	0.26827	0.38124	0.38138	0.36395	0.60099
COMP6	0.28245	0.22602	1.00000	0.16910	0.27543	0.19830	0.13537	0.47755
COMP7	0.26168	0.26827	0.16910	1.00000	0.43428	0.22290	0.31445	0.53360
COMP8	0.27322	0.38124	0.27543	0.43428	1.00000	0.31137	0.44955	0.66912
COMP9	0.35469	0.38138	0.19830	0.22290	0.31137	1.00000	0.41223	0.65445
COMP10	0.32759	0.36395	0.13537	0.31445	0.44955	0.41223	1.00000	0.66007
SCORE	0.62722	0.60099	0.47755	0.53360	0.66912	0.65445	0.66007	1.00000

TABLE C-1 (Cont'd)

Part B: Written and Hands-on Test

VARIABLE	MEAN	STANDARD DEV	CASES
GENSC	15.4091	3.1366	154
METERSC	19.3831	4.4298	154
OSCILLSC	11.5779	5.6647	154
PART2SC	8.9610	4.3112	154
PART1SC	46.3701	9.5116	154
SYMSC	18.7078	1.7930	154
CIRSC	35.8766	5.4836	154
COMPSC	56.1948	20.4572	154
BOARD1	12.3636	3.1391	154
BOARD2	12.2338	3.5199	154
BOARD3	10.3571	4.3064	154
BOARD4	11.1688	4.4557	154
BOARD5	11.7013	3.5482	154
BOARD6	10.6948	3.7422	154
BOARD7	11.3377	4.2105	154
BOARD8	9.5844	5.2427	154
BOARD9	11.5065	4.5060	154
BOARD10	9.8312	5.3636	154
SCORE	110.7792	25.7345	154
OVERALL	166.1104	29.5685	154

TABLE C-1 (Cont'd)

Part B: Written and Hands-on Test

Variable	Description
GENSC	General Electronics score, written
METERSC	Meters score, written
OSCILLSC	Oscilloscope score, written
PART2SC	Troubleshooting UIQ-10 Amplifier, written
PART1SC	GENSC plus METERSC plus OSCILLSC
SYMSC	Symptom score, hands-on
CIRSC	Circuit score, hands-on
COMPSC	Component score, hands-on
BOARD 1	BOARD 1 score, hands-on
BOARD 2	BOARD 2 score, hands-on
BOARD 3	BOARD 3 score, hands-on
BOARD 4	BOARD 4 score, hands-on
BOARD 5	BOARD 5 score, hands-on
BOARD 6	BOARD 6 score, hands-on
BOARD 7	BOARD 7 score, hands-on
BOARD 8	BOARD 8 score, hands-on
BOARD 9	BOARD 9 score, hands-on
BOARD 10	BOARD 10 score, hands-on
SCORE	Score on hands-on test
OVERALL	PART1SC plus PART2SC plus SCORE

TABLE C-1 (Cont'd)

	GENSC	METERSC	OSCILLSC	PART2SC	PART1SC	SYMSC	CIRSC	COMPSC	BOARD1	BOARD2	BOARD3	BOARD4
GENSC	1.00000	0.30193	0.23270	0.31439	0.60897	0.11670	0.12874	0.09980	0.20518	-0.02056	0.07379	0.14421
METERSC	0.30193	1.00000	0.24429	0.15479	0.71079	0.03558	0.08026	0.12467	0.03692	0.07973	-0.00790	0.09174
OSCILLSC	0.23270	0.24429	1.00000	0.26347	0.78607	0.00258	0.06628	0.00241	0.01824	-0.10909	0.03516	-0.01399
PART2SC	0.31439	0.15479	0.26347	1.00000	0.33268	0.09237	0.18724	0.08546	0.08509	0.15049	0.10742	0.11467
PART1SC	0.60897	0.71079	0.78607	0.33268	1.00000	0.05659	0.11930	0.09240	0.09572	-0.03462	0.04159	0.08195
SYMSC	0.11670	0.03558	0.00258	0.09237	0.05659	1.00000	0.53810	0.38895	0.23500	0.22424	0.28194	0.38991
CIRSC	0.12874	0.08026	0.06628	0.18724	0.11930	0.53810	1.00000	0.76382	0.39827	0.50335	0.55073	0.65864
COMPSC	0.09980	0.12467	0.00241	0.08546	0.09240	0.38895	0.76382	1.00000	0.49435	0.56104	0.66336	0.60926
BOARD1	0.20518	0.03692	0.01824	0.08509	0.09572	0.23500	0.39827	0.49435	1.00000	0.42526	0.32975	0.21053
BOARD2	-0.02056	0.07973	-0.10909	0.15049	-0.03462	0.22424	0.50335	0.56104	0.42526	1.00000	0.41789	0.34919
BOARD3	0.07379	-0.00790	0.03516	0.10742	0.04159	0.28194	0.55073	0.66336	0.32975	0.41789	1.00000	0.34598
BOARD4	0.14421	0.09174	-0.01399	0.11467	0.08195	0.38991	0.65864	0.60926	0.21053	0.34919	0.34598	1.00000
BOARD5	0.10384	0.06721	-0.03883	0.04025	0.04242	0.20399	0.43815	0.58969	0.09901	0.09355	0.40141	0.33642
BOARD6	0.02685	0.28466	0.01608	0.04180	0.15101	0.14248	0.27716	0.49920	0.09297	0.24660	0.30085	0.31003
BOARD7	0.06519	0.14895	0.03862	-0.01439	0.11387	0.17505	0.36841	0.52235	0.19636	0.16046	0.16669	0.23105
BOARD8	0.04379	0.05643	0.08825	0.02877	0.09328	0.36525	0.59294	0.66745	0.21417	0.23339	0.37601	0.32198
BOARD9	0.01530	0.06782	0.00152	0.12214	0.03753	0.48847	0.64929	0.61622	0.31589	0.33864	0.33587	0.38570
BOARD10	0.07134	-0.04650	0.01872	0.04296	0.01302	0.39378	0.66528	0.71021	0.30801	0.32614	0.37388	0.40759
SCORE	0.11489	0.11868	0.01621	0.11427	0.10282	0.49352	0.85776	0.98479	0.49421	0.56887	0.66432	0.65183
OVERALL	0.34173	0.35451	0.30539	0.35227	0.45967	0.46120	0.81222	0.89928	0.47333	0.50591	0.60723	0.61039

TABLE C-1 (Cont'd)

	BOARD5	BOARD6	BOARD7	BOARD8	BOARD9	BOARD10	SCORE	OVERALL
GENSC	0.10384	0.02685	0.06519	0.04379	0.01530	0.07134	0.11489	0.34173
METERSC	0.06721	0.28466	0.14895	0.05643	0.06782	-0.04650	0.11868	0.35451
OSCILLSC	-0.03883	0.01608	0.03862	0.08825	0.00152	0.01872	0.01621	0.30539
PART2SC	0.04025	0.04180	-0.01439	0.02877	0.12214	0.04296	0.11427	0.35227
PART1SC	0.04242	0.15101	0.11387	0.09328	0.03753	0.01302	0.10282	0.45967
SYMSC	0.20399	0.14248	0.17505	0.36525	0.48847	0.39378	0.49352	0.46120
CIRSC	0.43815	0.27716	0.36841	0.59294	0.64929	0.66528	0.85776	0.81222
COMPSC	0.58969	0.49520	0.52235	0.66745	0.61622	0.71021	0.98479	0.89928
BOARD1	0.09901	0.09297	0.19636	0.21417	0.31589	0.30801	0.49421	0.47333
BOARD2	0.09355	0.24660	0.16046	0.23339	0.33864	0.32614	0.56887	0.50591
BOARD3	0.40141	0.30085	0.16669	0.37601	0.33587	0.37388	0.66432	0.60723
BOARD4	0.33642	0.31003	0.23105	0.32198	0.38570	0.40759	0.65183	0.61039
BOARD5	1.00000	0.24708	0.25266	0.35588	0.35210	0.36824	0.57634	0.52112
BOARD6	0.24708	1.00000	0.15799	0.24668	0.16853	0.15176	0.46582	0.46009
BOARD7	0.25266	0.15799	1.00000	0.39249	0.16593	0.29600	0.50593	0.47486
BOARD8	0.35588	0.24668	0.39249	1.00000	0.32437	0.46049	0.68237	0.62809
BOARD9	0.35210	0.16853	0.16593	0.32437	1.00000	0.54226	0.66224	0.60625
BOARD10	0.36824	0.15176	0.29600	0.46049	0.54226	1.00000	0.73377	0.64908
SCORE	0.57634	0.46582	0.50593	0.68237	0.66224	0.73377	1.00000	0.92007
OVERALL	0.52112	0.46009	0.47486	0.62809	0.60625	0.64908	0.92007	1.00000

TABLE C-2

INTERCORRELATION AMONG PARTS OF HANDS-ON AND WRITTEN PROFICIENCY TESTS

AUTOMOTIVE MECHANIC

VARIABLE	MEAN	STANDARD DEV	CASES
RANK	3.1597	0.8938	263
MONOJT	0.4601	2.4396	263
MONEXP	17.3936	16.4767	263
PDEXP	3.8555	9.8466	263
HIGHSCH	4.6426	9.1252	263
TRADESCH	0.5285	2.6280	263
OTHEREX	1.0837	6.7156	263
M35	0.6996	0.4593	263
M54	0.5970	0.4914	263
M151	0.8821	0.3347	263
M561	0.3840	0.4873	263
M880	0.7452	0.4620	263
M813	0.2129	0.4102	263
FUEL	5.9620	1.9572	263
STEER	1.8251	0.8288	263
COOL	5.5894	1.3671	263
M54W	20.0304	5.7591	263
WRITTEN	33.4068	7.3623	263
COMPSC	7.4601	0.9356	263
COILSC	16.7072	2.8476	263
PLUGSC	2.1863	0.4780	263
VACSC	3.7909	0.6465	263
PTIMESC	6.5285	1.2893	263
ERO	7.4297	1.1231	263
BATTSC	9.3042	1.4849	263
ALTSC	7.0190	1.8000	263
WHEELSC	11.7110	2.4166	263
HOSCORE	72.1369	7.7265	263

TABLE C-2 (Cont'd)

Variable	Description
RANK	Enlisted grade
MONOJT	Months of on-the-job training
MONEXP	Months of experience as automotive mechanic in Marine Corps
PDEXP	Months of paid experience as mechanic in civilian life
HIGHSCH	High school courses in mechanics
OTHEREX	Other experience as mechanic in civilian life
M35	Experience with vehicle in Marine Corps
M54	Experience with vehicle in Marine Corps
M151	Experience with vehicle in Marine Corps
M561	Experience with vehicle in Marine Corps
M880	Experience with vehicle in Marine Corps
M813	Experience with vehicle in Marine Corps
FUEL	Score on Fuel system written test items
STEER	Score on Steering system written test items
COOL	Score on Cooling system written test items
M54W	Score on M54 (multifuel engine) truck written test items
WRITTEN	Total written test score
COMPSC	Compression score on hands-on test
COILSC	Coil score on hands-on test
PLUGSC	Sparkplug score on hands-on test
VACSC	Vacuum test score on hands-on test
PTIMESC	Precision timing score on hands-on test
ERO	Equipment repair order score on hands-on test
BATTSC	Battery test score on hands-on test
ALTSC	Alternator test score on hands-on test
WHEELSC	Wheel and brake score on hands-on test
HOSCORE	Total hands-on test score

TABLE C-2 (Cont'd)

	RANK	MONOJT	MONEXP	PDEXP	HIGHSCH	TRADESCH	OTHEREX	M35	M54	M151	M561	M880
RANK	1.00000	0.04845	0.50466	-0.00344	-0.04913	-0.03445	0.10396	0.17309	0.24268	0.13973	0.26178	0.21905
MONOJT	0.04845	1.00000	0.03325	0.10510	0.06657	-0.00592	0.16072	0.01480	-0.05804	0.01993	-0.04966	0.19580
MONEXP	0.50466	0.03325	1.00000	0.04836	-0.01406	-0.01227	-0.05936	0.25618	0.38580	0.23462	0.42798	0.25203
PDEXP	-0.00344	0.10510	0.04836	1.00000	0.26113	0.02140	0.01738	0.03932	-0.00262	0.03882	-0.00191	0.15463
HIGHSCH	-0.04913	0.06657	-0.01406	0.26113	1.00000	0.08207	0.02646	0.09541	0.07925	0.05739	0.00438	0.03807
TRADESCH	-0.03445	-0.00592	-0.01227	0.02140	0.08207	1.00000	-0.02911	-0.01975	-0.04722	0.00601	-0.05478	0.03272
OTHEREX	0.10396	0.16072	-0.05936	0.01738	0.02646	-0.02911	1.00000	0.02426	0.02529	0.08931	-0.07517	0.02904
M35	0.17309	0.01480	0.25618	0.03932	0.09541	-0.01975	0.02426	1.00000	0.42544	0.09158	0.17631	0.12364
M54	0.24268	-0.05804	0.38580	-0.00262	0.07925	-0.04722	0.02529	0.42544	1.00000	0.05815	0.29816	0.21846
M151	0.13973	0.01993	0.23462	0.03882	0.05739	0.00601	0.08931	0.09158	0.05815	1.00000	0.27862	0.47151
M561	0.26178	-0.04966	0.42798	-0.00191	0.00438	-0.05478	-0.07517	0.17631	0.29816	0.27862	1.00000	0.33447
M880	0.21905	0.19580	0.25203	0.15463	0.03807	0.03272	0.02904	0.12364	0.21846	0.47151	0.33447	1.00000
M813	-0.02023	-0.01054	-0.06766	0.05584	0.06426	-0.09418	0.07111	0.05716	0.06761	0.18353	0.20041	0.26719
FUEL	0.09731	-0.03309	0.04054	0.00268	-0.00034	-0.03689	-0.06509	0.05093	-0.07948	-0.01852	-0.06867	-0.06984
STEER	-0.03429	0.10414	-0.07008	0.07453	0.04671	0.01106	-0.00490	-0.07839	-0.21123	-0.00581	-0.11657	0.02274
COOL	0.13509	0.09005	0.12000	0.13394	0.21705	0.05108	0.08316	0.07634	0.14471	0.08567	0.11158	0.17818
M54W	0.22892	-0.02137	0.18725	0.13732	0.16304	0.08316	0.04642	0.19827	0.26327	0.08306	0.11143	0.12054
WRITTEN	0.22616	0.00293	0.17164	0.14139	0.17301	0.06597	0.03389	0.17398	0.18790	0.07530	0.07650	0.11137
COMPSC	0.08525	-0.00446	0.08102	0.08182	0.10741	0.06993	0.00661	0.01196	-0.09324	0.06415	0.06306	0.03377
COILSC	0.15341	-0.01240	0.13099	-0.02275	0.09349	0.06105	-0.02666	0.02881	-0.02737	0.17191	0.15285	0.11135
PLUGSC	0.06410	-0.00833	0.16702	0.05358	0.03545	0.02462	0.01058	0.15156	0.19088	0.04236	-0.01339	-0.00894
VACSC	0.14389	0.05398	0.07828	0.10136	0.05760	0.01139	-0.09354	0.04472	0.04604	0.00912	0.09840	0.02541
PTIMESC	0.08546	0.05345	0.09322	0.05534	0.08067	0.03327	0.01603	0.00485	0.01218	-0.00545	0.04629	0.00904
ERO	0.01884	0.07106	-0.01711	0.07121	0.14502	0.05985	0.01293	-0.03002	-0.07923	0.05402	-0.05855	0.02786
BATTSC	0.12431	0.04446	0.01899	0.07663	0.05510	0.03983	0.01313	-0.08378	-0.05103	0.01866	0.03839	0.03550
ALTSC	0.09538	-0.00113	0.04314	0.02040	0.14565	0.13342	-0.03455	-0.06232	-0.06465	0.03541	0.00905	-0.00792
WHEELSC	-0.00153	-0.10555	-0.01084	0.03529	0.04065	0.06801	0.02007	0.01778	-0.02131	0.06627	0.06867	0.11499
MOSCORE	0.14550	-0.00659	0.09835	0.06342	0.14626	0.10770	-0.01089	-0.00343	-0.04673	0.11401	0.10155	0.09320

TABLE C-2 (Cont'd)

	M813	FUEL	STEER	COOL	M54W	WRITTEN	COMPSC	COILSC	PLUGSC	VACSC	PTIMESC	ERO
RANK	-0.02023	0.09731	-0.03429	0.13509	0.22892	0.22616	0.08525	0.15341	0.06410	0.14389	0.08546	0.01884
MONOJT	-0.01054	-0.03309	0.10414	0.09005	-0.02137	0.00293	-0.00446	-0.01240	-0.00833	0.05398	0.05345	0.07106
MONEXP	-0.06766	0.04054	-0.07008	0.12000	0.18725	0.17164	0.08102	0.13099	0.16702	0.07828	0.09322	-0.01711
PDEXP	0.05584	0.00268	0.07453	0.13394	0.13732	0.14139	0.08182	-0.02275	0.05358	0.10136	0.05534	0.07121
HIGHSCH	0.06426	-0.00034	0.04671	0.21705	0.16304	0.17301	0.10741	0.09349	0.03545	0.05780	0.08067	0.14502
TRADESCH	-0.09418	-0.03689	0.01106	0.05108	0.08316	0.06597	0.06993	0.06105	0.02462	0.01139	0.03327	0.05985
OTHEREX	0.07111	-0.06509	-0.00490	0.08316	0.04642	0.03389	0.00661	-0.02666	0.01058	-0.09354	0.01603	0.01293
M35	0.05716	0.05093	-0.07839	0.07634	0.19827	0.17398	0.01196	0.02881	0.15156	0.04472	0.00485	-0.03002
M54	0.06761	-0.07548	-0.21123	0.14471	0.26327	0.18790	-0.09324	-0.02737	0.19088	0.04604	0.01218	-0.07923
M151	0.18353	-0.01852	-0.00581	0.08567	0.08306	0.07530	0.06415	0.17191	0.04236	0.00912	-0.00545	0.05402
M561	0.20041	-0.06867	-0.11657	0.11158	0.11143	0.07650	0.06306	0.15285	-0.01339	0.09840	0.04629	-0.05855
M880	0.26719	-0.06984	0.02274	0.17818	0.12054	0.11137	0.03377	0.11135	-0.00894	0.02541	0.00904	0.02786
M813	1.00000	-0.01365	0.02015	0.12931	0.05219	0.06347	0.00234	0.10587	-0.04737	0.11100	0.06787	0.09893
FUEL	-0.01365	1.00000	0.12766	0.19671	0.30588	0.55600	0.10756	0.09798	-0.00464	0.01481	0.09875	-0.00296
STEER	0.02015	0.12766	1.00000	0.00711	-0.00848	0.14119	0.08449	0.03482	-0.07158	-0.01866	0.06541	0.02774
COOL	0.12931	0.19671	0.00711	1.00000	0.40348	0.55440	0.12142	0.16313	-0.03433	0.04066	0.06081	0.11536
M54W	0.05219	0.30588	-0.00848	0.40348	1.00000	0.93752	0.11640	0.21630	0.08528	0.04477	0.12890	0.09711
WRITTEN	0.06347	0.55600	0.14119	0.55440	0.93752	1.00000	0.15170	0.22945	0.05104	0.04441	0.14574	0.09972
COMPSC	0.00234	0.10756	0.08449	0.12142	0.11640	0.15170	1.00000	0.39316	-0.02171	0.29851	0.41150	0.23979
COILSC	0.10587	0.09798	0.03482	0.16313	0.21630	0.22945	0.39316	1.00000	-0.00464	0.31908	0.26582	0.31041
PLUGSC	-0.04737	-0.00464	-0.07158	-0.03433	0.08528	0.05104	-0.02171	-0.00464	1.00000	0.07716	0.06256	0.18447
VACSC	0.11100	0.01481	-0.01866	0.04066	0.04477	0.04441	0.29851	0.31908	0.07716	1.00000	0.40786	0.29771
PTIMESC	0.06787	0.09875	0.06541	0.06081	0.12890	0.14574	0.41150	0.26582	0.06256	0.40786	1.00000	0.17998
ERO	0.09893	-0.00296	0.02774	0.11536	0.09711	0.09972	0.23979	0.31041	0.18447	0.29771	0.17998	1.00000
BATTSC	-0.01275	0.00005	0.17677	0.02981	0.07256	0.08221	0.26704	0.36055	-0.02100	0.37666	0.22871	0.16165
ALTSC	0.06170	0.09771	0.19924	0.02025	0.08168	0.11606	0.20783	0.19619	-0.16825	0.16087	0.22590	0.10168
WHEELSC	0.10467	0.13728	0.21098	0.11876	0.08071	0.14543	0.31225	0.22893	-0.12502	0.16884	0.17783	0.15843
HOSCORE	0.11602	0.13184	0.17840	0.15060	0.19667	0.23694	0.59054	0.71864	0.01890	0.51619	0.53102	0.45945

TABLE C-2 (Cont'd)

	BATTSC	ALTSC	WHEELSC	HOSCORE
RANK	0.12431	0.09538	-0.00153	0.14550
MONOJT	0.04446	-0.00113	-0.10555	-0.00659
MONEXP	0.01899	0.04314	-0.01084	0.09835
POEXP	0.07663	0.02040	0.03529	0.06342
HIGHSCH	0.05510	0.14565	0.04065	0.14626
TRADESCH	0.03963	0.13342	0.06801	0.10770
OTHEREX	0.01313	-0.03455	0.02007	-0.01089
M35	-0.08378	-0.06232	0.01778	-0.00343
M54	-0.05103	-0.06465	-0.02131	-0.04673
M151	0.01866	0.03541	0.06627	0.11401
M561	0.03839	0.00905	0.06867	0.10155
M880	0.03550	-0.00792	0.11499	0.09320
M813	-0.01275	0.06170	0.10467	0.11602
FUEL	0.00005	0.09771	0.13728	0.13184
STEER	0.17677	0.19524	0.21098	0.17840
COOL	0.02981	0.02025	0.11876	0.15060
M54W	0.07256	0.08168	0.08071	0.19667
WRITTEN	0.08221	0.11606	0.14543	0.23694
COMPSC	0.26704	0.20783	0.31225	0.59054
COILSC	0.36055	0.19619	0.22893	0.71864
PLUGSC	-0.02100	-0.16825	-0.12502	0.01890
VACSC	0.37666	0.16087	0.16884	0.51619
PTIMESC	0.22871	0.22590	0.17783	0.53102
ERU	0.16165	0.10168	0.15843	0.45945
BATTSC	1.00000	0.37340	0.43411	0.67203
ALTSC	0.37340	1.00000	0.32592	0.55966
WHEELSC	0.43411	0.32592	1.00000	0.65340
HOSCORE	0.67203	0.55966	0.65340	1.00000

TABLE C-3

INTERCORRELATION AMONG PARTS OF HANDS-ON AND WRITTEN PROFICIENCY TESTS

INFANTRY RIFLEMAN

VARIABLE	MEAN	STANDARD DEV	CASES
PARTASC	4.5026	1.3768	384
PARTBSC	2.8281	0.8057	384
PARTCSC	12.0964	3.1196	384
PARTDSC	2.2422	1.7851	384
PARTESC	11.9036	3.4184	384
PARTFSC	8.7487	2.9331	384
PARTGSC	3.1719	1.4203	384
PARTHSC	7.4349	2.6616	384
PARTISC	3.2930	1.0813	384
WRITTEN	56.2214	10.7177	384
MAPCOMP	34.2406	15.2179	384
FIRSTAID	16.5180	5.7113	384
FIRETEAM	14.5156	5.6203	384
ANTITK1	12.8380	7.2860	384
ANTITK2	11.5770	5.3593	384
ANTITK	26.4150	10.0213	384
FIRINGSC	49.0260	22.0142	384
HANDSON	138.7153	37.5857	384
RIFEXP	2.3464	1.4765	384
EXPR	2.2057	0.9123	384
ITSEXP	2.2344	0.9814	384
RANK	1.9609	0.7377	384
TIMESERV	11.1094	5.7287	384
MONITS	6.3672	8.2837	384
MONRIF	2.6054	4.6690	384

TABLE C-3 (Cont'd)

Variable	Description
Part A	Infantry assignments
Part B	Rifleman duties
Part C	Weapon characteristics
Part D	Handling prisoners - 1
Part E	Handling prisoners - 2
Part F	Identify acronyms
Part G	Definition of acronyms
Part H	Nuclear, biological, chemical defense
Part I	Identification of targets
Written	Written test score sum of Parts A through I
MAPCOMP	Map and compass test
FIRSTAID	Perform first aid on dummies
FIRETEAM	Signals, formations, movement of fire team
ANTITK1	Locate and neutralize mine
ANTITK2	Set up antipersonnel mine
ANTITK	Sum of ANTITK 1 and 2
FIRINGSC	Fire rifle at 23 pop-up targets
HANDS-ON	Hands-on test score sum of hands-on parts
RIFEXP	Self-report of experience as rifleman
EXP	Self-report of experience in Marine Corps
ITSEXP	Self-report of experience since Infantry Training School
RANK	Enlisted grade
TIMESERV	Self-report of months in service
MONITS	Self-report of months since Infantry Training School
MONRIF	Self-report of months as rifleman

TABLE C-3 (Cont'd)

	PARTASC	PARTBSC	PARTCSC	PARTDSC	PARTESC	PARTFSC	PARTGSC	PARTHSC	PARTISC	WRITTEN	MAPCOMP	FIRSTAID
PARTASC	1.00000	0.21929	0.37288	0.03214	0.18673	0.25798	0.30686	0.19753	0.17794	0.50035	0.35330	0.12049
PARTBSC	0.21929	1.00000	0.24343	0.03265	0.16555	0.14905	0.15820	0.16046	0.15534	0.35271	0.24088	0.11291
PARTCSC	0.37288	0.24343	1.00000	0.12520	0.31133	0.28700	0.34273	0.34129	0.28922	0.72169	0.51100	0.26402
PARTDSC	0.03214	0.03265	0.12520	1.00000	0.00041	-0.00131	-0.01440	0.11273	0.07474	0.24509	0.09760	0.10430
PARTESC	0.18673	0.16555	0.31133	0.00041	1.00000	0.25291	0.25832	0.27227	0.19167	0.64155	0.31615	0.14521
PARTFSC	0.25798	0.14905	0.28700	-0.00131	0.25291	1.00000	0.45976	0.22754	0.06979	0.61072	0.27423	0.20602
PARTGSC	0.30686	0.15820	0.34273	-0.01440	0.25832	0.45976	1.00000	0.30018	0.17539	0.58725	0.37878	0.17224
PARTHSC	0.19753	0.16046	0.34129	0.11273	0.27227	0.22754	0.30018	1.00000	0.21608	0.63324	0.34250	0.11235
PARTISC	0.17794	0.15534	0.28922	0.07474	0.19167	0.06979	0.17539	0.21608	1.00000	0.39323	0.27446	0.09319
WRITTEN	0.50035	0.35271	0.72169	0.24509	0.64155	0.61072	0.58725	0.63324	0.39323	1.00000	0.57434	0.28311
MAPCOMP	0.35330	0.24088	0.51100	0.09760	0.31815	0.27423	0.37878	0.34250	0.27446	0.57434	1.00000	0.24306
FIRSTAID	0.12049	0.11291	0.26402	0.10430	0.14521	0.20602	0.17224	0.11235	0.09319	0.28311	0.24306	1.00000
FIRETEAM	0.22725	0.16740	0.32805	-0.03200	0.28636	0.26550	0.36337	0.21509	0.13061	0.41619	0.41865	0.16567
ANTITK1	0.14711	0.04338	0.25318	0.06447	0.15063	0.09289	0.11212	0.18662	0.15933	0.26081	0.35821	0.06613
ANTITK2	0.20794	0.04626	0.25403	0.04509	0.19681	0.15756	0.13218	0.14885	0.17296	0.29224	0.30878	0.24517
ANTITK	0.21616	0.05628	0.31992	0.07098	0.21476	0.15180	0.15221	0.21529	0.20834	0.34591	0.42557	0.17919
FIRINGSC	0.05535	-0.01800	0.09292	0.00050	0.08733	0.04268	-0.00424	0.04914	0.17172	0.10282	0.15212	0.06064
HANDSGN	0.28826	0.14717	0.43579	0.06980	0.30211	0.24751	0.27197	0.27409	0.30094	0.49025	0.70698	0.35843
RIFEXP	-0.17191	-0.05249	-0.15124	-0.00615	-0.11597	-0.10766	-0.03469	-0.05861	-0.09643	-0.17051	-0.10253	-0.09279
EXPR	-0.11164	-0.00505	-0.08038	0.03506	-0.07986	-0.07625	-0.08378	0.00164	0.01947	-0.06732	-0.12793	0.00487
ITSEXP	-0.11832	-0.01166	-0.05856	0.05842	-0.07419	-0.04887	-0.06643	0.00638	0.06307	-0.06117	-0.06103	0.00640
RANK	-0.05260	0.07653	-0.01084	0.09048	-0.02945	0.02984	-0.01102	0.06723	0.06512	0.03808	0.06856	0.03157
TIMESERV	-0.08611	-0.02194	-0.07510	0.03800	-0.07452	-0.07831	-0.08446	0.01827	0.02874	-0.07685	-0.08518	0.00376
MONITS	-0.03088	-0.02103	-0.10544	0.03211	-0.06956	-0.04522	-0.04421	-0.02328	0.01449	-0.08701	-0.03818	-0.01232
MONRIF	-0.13509	-0.05632	-0.12988	0.00793	-0.12849	-0.11977	-0.06977	-0.06952	-0.07812	-0.17053	-0.11204	-0.16012

TABLE C-3 (Cont'd)

	FIRETEAM	ANTITK1	ANTITK2	ANTITK	FIRINGSC	HANDSUN	RIFEXP	EXPR	ITSEXP	RANK	TIMESERV	MONITS
PARTASC	0.22725	0.14711	0.20794	0.21616	0.05935	0.28826	-0.17191	-0.11164	-0.11832	-0.05260	-0.08611	-0.03088
PARTBSC	0.18740	0.04338	0.04626	0.05628	-0.01800	0.14717	-0.09249	-0.00505	-0.01166	0.07653	-0.02194	-0.02103
PARTCSC	0.32805	0.25318	0.25403	0.31992	0.09292	0.43579	-0.15124	-0.08038	-0.05856	-0.01084	-0.07510	-0.10544
PARTDSC	-0.03200	0.06447	0.04509	0.07098	0.00050	0.06980	-0.00615	0.03506	0.05842	0.09048	0.03800	0.03211
PARTESC	0.28636	0.15063	0.19681	0.21476	0.08733	0.30211	-0.11597	-0.07986	-0.07419	-0.02945	-0.07452	-0.06956
PARTFSC	0.26550	0.09289	0.15756	0.15180	0.04268	0.24751	-0.10766	-0.07625	-0.04887	0.02984	-0.07831	-0.08522
PARTGSC	0.36337	0.11212	0.13218	0.15221	-0.00424	0.27197	-0.03469	-0.08378	-0.06643	-0.01102	-0.06446	-0.04421
PARTHSC	0.21509	0.18662	0.14865	0.21529	0.04914	0.27409	-0.05861	0.00164	0.00638	0.08723	0.01827	-0.02328
PARTISC	0.13061	0.15533	0.17296	0.20834	0.17172	0.30094	-0.09643	0.01947	0.06307	0.06512	0.02874	0.01449
WRITTEN	0.41619	0.26081	0.29224	0.34591	0.10282	0.49025	-0.17051	-0.08732	-0.06117	0.03808	-0.07685	-0.08701
MAPCOMP	0.41665	0.35821	0.30878	0.42557	0.15212	0.70698	-0.10253	-0.12793	-0.06103	0.06856	-0.08518	-0.03818
FIRSTAID	0.16567	0.06613	0.24517	0.17919	0.06064	0.35843	-0.09279	0.00487	0.00640	0.03157	0.00376	-0.01232
FIRETEAM	1.00000	0.12135	0.13050	0.15802	0.06185	0.42257	-0.08514	-0.21833	-0.17533	-0.06566	-0.21211	-0.12544
ANTITK1	0.12135	1.00000	0.23841	0.85455	0.23722	0.54001	-0.06014	0.00809	-0.01739	0.08085	0.01887	-0.02407
ANTITK2	0.13050	0.23841	1.00000	0.70813	0.12994	0.44670	-0.09570	-0.07874	-0.03464	-0.00193	-0.04812	-0.03519
ANTITK	0.15802	0.85455	0.70813	1.00000	0.24196	0.63151	-0.09491	-0.03622	-0.03117	0.05775	-0.01201	-0.03632
FIRINGSC	0.06185	0.23722	0.12994	0.24196	1.00000	0.73027	0.00960	-0.02159	0.01917	-0.04496	-0.02555	-0.02199
HANDSON	0.42257	0.54001	0.44670	0.63151	0.73027	1.00000	-0.08802	-0.10601	-0.04704	0.01181	-0.08380	-0.05865
RIFEXP	-0.08514	-0.06014	-0.09570	-0.09491	0.00960	-0.08802	1.00000	0.36566	0.42312	0.26416	0.35204	0.34843
EXPR	-0.21833	0.00809	-0.07874	-0.03622	-0.02159	-0.10601	0.36566	1.00000	0.84420	0.56619	0.90045	0.64436
ITSEXP	-0.17533	-0.01739	-0.03464	-0.03117	0.01917	-0.04704	0.42312	0.84420	1.00000	0.58971	0.79047	0.72837
RANK	-0.06566	0.08085	-0.00193	0.05775	-0.04496	0.01181	0.26416	0.58619	0.58971	1.00000	0.53916	0.37238
TIMESERV	-0.21211	0.01887	-0.04812	-0.01201	-0.02555	-0.08380	0.35204	0.90045	0.79047	0.53916	1.00000	0.69235
MONITS	-0.12544	-0.02407	-0.03519	-0.03632	-0.02199	-0.05865	0.34843	0.64436	0.72837	0.37238	0.69235	1.00000
MONRIF	-0.08106	-0.06469	-0.11821	-0.11025	0.01491	-0.10248	0.76239	0.40448	0.39723	0.19266	0.47484	0.40248

TABLE C-3 (Cont'd)

	MONRIF
PARTASC	-0.13509
PARTBSC	-0.09632
PARTCSC	-0.12988
PARTDSC	0.00793
PARTESC	-0.12849
PARTFSC	-0.11977
PARTGSC	-0.06977
PARTHSC	-0.06952
PARTISC	-0.07812
WRITTEN	-0.17053
MAPCOMP	-0.11204
FIRSTAID	-0.16012
FIRETEAM	-0.08106
ANTITK1	-0.06469
ANTITK2	-0.11821
ANTITK	-0.11025
FIRINGSC	0.01491
HANDSON	-0.10248
RIFEXP	0.78239
EXPM	0.40448
ITSEXP	0.39723
RANK	0.19266
TIMESERV	0.47484
MONITS	0.40248
MONRIF	1.00000

TABLE C-4

INTERCORRELATION MATRICES FOR FINAL SAMPLE
GROUND RADIO REPAIR

Part A: Uncorrected Correlation Matrix

	Mean	Standard deviation
ARGI	11.712	2.364
ARNO	37.695	6.906
ARAO	15.763	3.213
ARWK	25.356	4.122
ARAR	17.169	2.379
ARSP	16.136	3.277
ARMK	16.797	2.462
AREI	23.492	3.757
ARMC	14.763	2.996
ARGS	15.390	2.754
ARSI	16.169	3.147
ARAI	13.898	4.369
ARCM	12.576	4.680
ARCA	9.932	2.434
ARCE	11.085	4.149
ARCC	19.339	4.361
DRCO	82.949	8.603
DRFA	76.051	10.061
DRMM	81.542	12.688
DRGM	60.458	8.724
DRCL	67.492	8.508
DRGT	41.559	5.200
DREL	69.102	9.121
DRSC	72.949	7.895
DRST	46.203	6.685
DROF	35.898	6.761
DRGCT	57.881	5.954
WRSTAND	48.845	9.260
HOCST	50.783	10.005
PROFICST	48.964	9.793
FCGST	48.996	10.246
HOCTOTST	49.152	9.635

N OF CASES = 59

TABLE C-4 (Cont'd)

Variable	Description
ARGI	General Information subtest raw score, tested at AFEES[a]
ARNO	Numerical Operations subtest raw score, tested at AFEES
ARAD	Attention to Detail subtest raw score, tested at AFEES
ARWK	Word Knowledge subtest raw score, tested at AFEES
ARAR	Arithmetic Reasoning subtest raw score, tested at AFEES
ARSP	Space Perception subtest raw score, tested at AFEES
ARMK	Mathematics Knowledge subtest raw score, tested at AFEES
AREI	Electronics Information subtest raw score, tested at AFEES
ARMC	Mechanical Comprehension subtest raw score, tested at AFEES
ARGS	General Science subtest raw score, tested at AFEES
ARSI	Shop Information subtest raw score, tested at AFEES
ARAI	Automotive Information subtest raw score, tested at AFEES
ARCM	Mechanical Interest subtest raw score, tested at AFEES
ARCA	Attentiveness Interest subtest raw score, tested at AFEES
ARCE	Electronics Interest subtest raw score, tested at AFEES
ARCC	Combat Interest subtest raw score, tested at AFEES
DRCO	Combat aptitude composite raw score, tested at Depot
DRFA	Field Artillery composite raw score, tested at Depot
DRMM	Mechanical Maintenance composite raw score, tested at Depot
DRGM	General Maintenace composite raw score, tested at Depot
DRCL	Clerical composite raw score, tested at Depot
DRGT	General Technical composite raw score, tested at Depot
DREL	Electronics Repair composite raw score, tested at Depot
DRSC	Surveillance/Communications composite raw score, tested at Depot
DRST	Skilled Technical composite raw score, tested at Depot
DROF	Operators/Food composite raw score, tested at Depot
DRGCT	AFQT raw score, tested at Depot
WRSTAND	Written test, standardized
HOCST	Hands-on test, standardized
PROFICST	WRSTAND plus HOCST plus FCGST, standardized
FCGST	Final Course Grade, standardized
HOCTOTST	HOCST plus WRSTAND, standardized

[a]Forms 6 and 7 of the ASVAB.

TABLE C-4 (Cont'd)

	ARGI	ARNO	ARAD	ARWK	ARAR	ARSP	ARMK	AREI	ARMC	ARGS	ARSI
ARGI	1.000	.017	.059	.563	.098	-.035	.093	.187	-.000	.417	.143
ARNO	.017	1.000	.289	.158	.278	.168	.428	-.154	.106	.004	-.112
ARAD	.059	.289	1.000	.068	.141	.152	.111	-.094	-.022	.020	-.016
ARWK	.563	.158	.068	1.000	.324	.041	.347	.259	.237	.563	.103
ARAR	.098	.278	.141	.324	1.000	.161	.327	.100	.192	.287	.049
ARSP	-.035	.168	.152	.041	.161	1.000	.335	.216	.390	.233	.302
ARMK	.093	.428	.111	.347	.327	.335	1.000	.030	.300	.332	-.056
AREI	.137	-.154	-.094	.259	.100	.216	.030	1.000	.438	.401	.651
ARMC	-.000	.106	-.022	.237	.192	.390	.300	.438	1.000	.421	.304
ARGS	.417	.004	.020	.563	.287	.233	.332	.401	.421	1.000	.360
ARSI	.143	-.112	-.016	.103	.049	.302	-.056	.651	.304	.360	1.000
ARAI	.314	-.134	-.013	.263	.277	.218	.075	.615	.470	.435	.611
ARCM	.190	-.110	.080	.157	.099	.186	.087	.416	.204	.413	.396
ARCA	.137	.293	.229	.260	.100	-.018	.216	.032	.047	.246	-.089
ARCE	-.075	.099	.322	-.061	-.003	.118	.014	.273	-.008	.208	.233
ARCC	.182	-.140	-.186	.120	-.050	.000	.026	.190	.056	.061	.135
DRCO	.149	.140	.300	.218	.296	.375	.280	.341	.230	.189	.307
DRFA	.433	.255	.033	.514	.497	.233	.467	.427	.309	.399	.289
DRMM	.337	-.055	-.059	.324	.297	.345	.221	.668	.391	.418	.550
DRGM	.343	.188	-.012	.566	.434	.321	.323	.584	.531	.628	.469
DRCL	.353	.322	.322	.630	.443	.199	.422	.007	.212	.321	.039
DRGT	.403	.178	.123	.784	.458	.093	.382	.228	.343	.490	.114
DREL	.368	.332	-.001	.517	.499	.227	.498	.457	.429	.476	.275
DRSC	.305	.198	.065	.660	.459	.433	.384	.470	.525	.550	.327
DRST	.314	.444	.112	.525	.556	.214	.614	.271	.419	.496	.207
DROF	.501	.007	-.043	.525	.293	.219	.191	.516	.293	.452	.452
DRGCT	.306	.205	.095	.668	.490	.339	.419	.359	.472	.488	.205
WRSTAND	.214	.225	.115	.382	.220	-.048	.235	.259	.199	.428	.234
HOCST	.119	.026	.175	.310	.399	.444	.315	.188	.265	.228	.073
PROFICST	.262	.244	.160	.419	.484	.246	.392	.325	.305	.354	.176
FCGST	.216	.262	.046	.192	.384	.103	.267	.234	.174	.101	.071
HOCTOTST	.219	.152	.195	.459	.417	.277	.369	.296	.311	.432	.200

TABLE C-4 (Cont'd)

	ARAI	ARCM	ARCA	ARCE	ARCC	ORCO	DRFA	DRMM	DRGM	DRCL	DRGT
ARGI	.314	.130	.137	-.075	.182	.149	.433	.337	.343	.353	.403
ARNO	-.134	-.110	.293	.099	-.140	.140	.265	-.055	.188	.322	.178
ARAD	-.013	.080	.229	.322	-.186	.300	.033	-.059	-.012	.322	.123
ARWK	.263	.157	.260	-.061	.120	.218	.514	.324	.566	.630	.784
ARAR	.277	.099	.100	-.003	-.050	.296	.497	.297	.434	.443	.458
ARSP	.219	.196	-.018	.118	.000	.375	.233	.345	.321	.199	.093
ARMK	.075	.087	.216	.014	.026	.280	.467	.221	.323	.422	.382
AREI	.615	.416	.032	.273	.190	.341	.427	.668	.584	.007	.228
ARMC	.470	.204	.047	-.008	.056	.230	.309	.391	.531	.212	.343
ARGS	.435	.413	.246	.208	.061	.189	.399	.418	.628	.321	.490
ARSI	.511	.396	-.089	.233	.135	.307	.289	.550	.469	.039	.114
ARAI	1.000	.511	-.077	.151	.069	.392	.468	.700	.616	.190	.295
ARCM	.511	1.000	.019	.368	.379	.402	.216	.626	.489	.137	.125
ARCA	-.077	.019	1.000	.342	-.237	.017	.280	.005	.144	.444	.406
ARCE	.151	.368	.342	1.000	-.038	.255	.221	.246	.175	.130	-.010
ARCC	.069	.379	-.237	-.038	1.000	.201	.105	.247	.224	-.066	.016
ORCO	.392	.402	.017	.255	.201	1.000	.531	.634	.529	.535	.368
DRFA	.468	.216	.280	.221	.105	.531	1.000	.727	.728	.571	.602
DRMM	.700	.626	.005	.246	.247	.634	.727	1.000	.777	.304	.380
DRGM	.616	.489	.144	.175	.224	.529	.728	.777	1.000	.498	.636
DRCL	.190	.137	.444	.130	-.066	.535	.571	.304	.498	1.000	.845
DRGT	.295	.125	.406	-.010	.016	.368	.602	.380	.636	.845	1.000
DREL	.442	.264	.271	.195	.024	.500	.917	.732	.807	.531	.641
DRSC	.430	.174	.261	.115	.052	.548	.751	.620	.803	.609	.776
DRST	.346	.180	.283	.089	.010	.511	.824	.545	.746	.615	.680
DPOF	.655	.463	.070	.189	.357	.451	.741	.744	.775	.456	.467
DRGCT	.377	.110	.296	.067	-.032	.518	.718	.535	.686	.686	.842
WRSTAND	.111	.093	.282	.105	-.160	.071	.291	.204	.239	.250	.329
HOCST	.325	-.099	.046	-.145	-.055	.302	.251	.172	.245	.325	.357
PROFICST	.351	.018	.202	-.053	-.185	.259	.430	.352	.358	.384	.469
FCGST	.288	.048	.105	-.060	-.173	.159	.355	.355	.264	.227	.296
HOCTOTST	.296	-.009	.213	-.033	-.140	.255	.360	.250	.323	.385	.458

TABLE C-4 (Cont'd)

	DREL	DRSC	DRST	DROF	DRGCT	WRSTAND	HOCST	PROFICST	FCGST	HOCTOTST
ARGI	.368	.306	.314	.501	.306	.214	.119	.262	.216	.219
ARNO	.332	.138	.444	.007	.205	.225	.026	.244	.262	.162
ARAD	-.001	.065	.112	-.043	.095	.115	.175	.160	.046	.195
ARWK	.517	.660	.525	.525	.668	.382	.310	.419	.192	.459
ARAR	.499	.459	.556	.293	.490	.220	.399	.484	.384	.417
ARSP	.227	.433	.214	.219	.339	-.048	.444	.246	.103	.277
ARMK	.498	.384	.614	.191	.419	.235	.315	.392	.267	.369
AREI	.457	.470	.271	.516	.359	.259	.188	.325	.234	.296
ARMC	.429	.525	.419	.293	.472	.199	.265	.305	.174	.311
ARGS	.476	.550	.496	.452	.488	.428	.228	.354	.101	.432
ARSI	.275	.327	.207	.452	.205	.234	.073	.176	.071	.200
ARAI	.442	.430	.346	.655	.377	.111	.325	.351	.288	.296
ARCM	.264	.174	.180	.463	.110	.093	-.099	.018	.048	-.009
ARCA	.271	.261	.283	.070	.296	.282	.046	.202	.105	.213
ARCE	.195	.115	.089	.189	.067	.105	-.145	-.053	-.060	-.033
ARCC	.024	.052	.010	.357	-.032	-.160	-.055	-.185	-.173	-.140
DRCO	.500	.548	.511	.451	.518	.071	.302	.259	.159	.255
DRFA	.917	.751	.824	.741	.718	.291	.251	.430	.355	.360
DRMM	.732	.620	.545	.744	.535	.204	.172	.352	.355	.250
DRGM	.807	.803	.746	.775	.686	.239	.245	.358	.264	.323
DRCL	.531	.609	.615	.456	.686	.250	.325	.384	.227	.385
DRGT	.641	.776	.680	.467	.842	.329	.357	.469	.296	.458
DREL	1.000	.800	.905	.580	.768	.337	.207	.466	.428	.359
DRSC	.800	1.000	.762	.567	.956	.350	.437	.538	.338	.527
DRST	.905	.762	1.000	.472	.759	.348	.245	.457	.363	.393
DROF	.580	.567	.472	1.000	.478	.137	.199	.249	.182	.225
DRGCT	.768	.956	.759	.478	1.000	.373	.446	.590	.411	.548
WRSTAND	.337	.350	.348	.137	.373	1.000	.124	.665	.310	.727
HOCST	.207	.437	.245	.199	.446	.124	1.000	.665	.245	.772
PROFICST	.466	.538	.457	.249	.590	.665	.665	1.000	.757	.886
FCGST	.428	.338	.363	.182	.411	.310	.245	.757	1.000	.368
HOCTOTST	.359	.527	.393	.225	.548	.727	.772	.886	.368	1.000

TABLE C-4 (Cont'd)

Part B: Corrected Correlation Matrix

	Mean	Standard deviation
ARGI	11.712	3.200
ARNO	37.695	10.500
ARAD	15.763	4.000
ARWK	25.356	7.000
ARAR	17.170	4.700
ARSP	16.136	4.200
ARMK	16.797	4.900
AREI	23.492	5.700
ARMC	14.763	4.500
ARGS	15.390	4.300
ARSI	16.170	4.200
ARAI	13.898	4.800
ARCM	12.576	4.200
ARCA	9.932	3.000
ARCE	11.085	4.600
ARCC	19.339	3.800
ORCO	82.949	11.916
ORFA	76.051	20.613
ORMM	81.542	18.590
ORGM	60.458	15.347
ORCL	67.492	13.516
ORGT	41.559	8.969
OREL	69.102	18.877
ORSC	72.949	15.489
ORST	46.203	14.142
OROF	35.898	9.977
ORGCT	57.881	11.304
WRSTAND	48.845	13.765
HOCST	50.783	14.576
PROFICST	48.964	17.189
FCGST	48.996	14.679
HOCTOTST	49.152	16.397

N OF CASES = 59

TABLE C-4 (Cont'd)

	ARGI	ARNO	ARAD	ARWK	ARAR	ARSP	ARMK	AREI	ARMC	ARGS	ARSI
ARGI	1.000	.492	.196	.728	.608	.446	.557	.657	.598	.664	.614
ARNO	.492	1.000	.424	.495	.631	.417	.633	.452	.476	.490	.426
ARAD	.196	.424	1.000	.186	.291	.285	.270	.196	.229	.186	.209
ARWK	.728	.495	.186	1.000	.725	.504	.658	.720	.664	.795	.642
ARAR	.608	.631	.291	.725	1.000	.575	.781	.635	.690	.693	.569
ARSP	.446	.417	.285	.504	.575	1.000	.515	.534	.620	.500	.513
ARMK	.557	.633	.270	.658	.781	.515	1.000	.592	.625	.672	.472
AREI	.657	.452	.196	.720	.635	.534	.592	1.000	.707	.699	.708
ARMC	.598	.476	.229	.664	.690	.620	.625	.707	1.000	.699	.671
ARGS	.664	.490	.186	.795	.693	.500	.672	.699	.699	1.000	.642
ARSI	.614	.426	.209	.642	.569	.513	.472	.708	.671	.642	1.000
ARAI	.596	.397	.142	.594	.549	.461	.465	.712	.669	.606	.733
ARCM	.143	.028	.028	.059	.070	.135	.016	.262	.229	.095	.302
ARCA	.186	.247	.140	.284	.275	.184	.273	.177	.149	.236	.088
ARCE	.120	.181	.122	.140	.212	.214	.241	.255	.222	.208	.136
ARCC	.368	.236	.121	.332	.283	.261	.227	.323	.337	.332	.386
DRCO	.556	.541	.429	.601	.691	.621	.649	.650	.621	.518	.584
DRFA	.749	.629	.204	.797	.859	.597	.827	.758	.729	.719	.649
DRMM	.700	.464	.122	.697	.720	.612	.655	.814	.731	.626	.711
DRGM	.725	.632	.214	.845	.811	.621	.707	.817	.801	.818	.747
DRCL	.641	.533	.309	.806	.786	.576	.702	.545	.661	.613	.578
DRGT	.683	.506	.232	.908	.806	.539	.711	.680	.714	.749	.634
DREL	.742	.656	.191	.796	.860	.576	.830	.783	.768	.746	.653
DRSC	.706	.552	.233	.890	.830	.695	.727	.784	.792	.796	.692
DRST	.713	.711	.282	.795	.883	.559	.872	.722	.760	.778	.659
DROF	.745	.506	.138	.800	.707	.579	.616	.746	.687	.698	.713
DRGCT	.693	.546	.231	.883	.839	.657	.750	.750	.774	.766	.649
WRSTAND	.614	.570	.261	.714	.684	.346	.670	.666	.619	.727	.621
HOCST	.470	.405	.357	.650	.677	.662	.620	.575	.530	.603	.432
PROFICST	.663	.625	.334	.762	.824	.579	.781	.749	.676	.723	.600
FCGST	.599	.601	.223	.558	.712	.443	.676	.645	.556	.497	.463
HOCTOTST	.622	.559	.357	.785	.784	.586	.742	.714	.660	.764	.604

TABLE C-4 (Cont'd)

	ARAI	ARCM	ARCA	ARCE	ARCC	DRCO	DRFA	DRMM	DRGM	DRCL	DRGT
ARGI	.596	.143	.186	.120	.368	.556	.749	.700	.725	.641	.683
ARNO	.397	.028	.247	.181	.236	.541	.629	.464	.632	.533	.506
ARAD	.142	.028	.140	.122	.121	.429	.204	.122	.214	.309	.232
ARWK	.594	.059	.284	.140	.332	.601	.797	.697	.845	.806	.908
ARAR	.549	.070	.275	.212	.283	.691	.859	.720	.811	.786	.806
ARSP	.461	.135	.184	.214	.261	.621	.597	.612	.621	.576	.539
ARMK	.465	.016	.273	.241	.227	.649	.827	.655	.707	.702	.711
AREI	.712	.262	.177	.255	.323	.650	.758	.814	.817	.545	.680
ARMC	.669	.229	.149	.222	.337	.621	.729	.731	.801	.661	.714
ARGS	.606	.095	.236	.208	.332	.518	.719	.626	.818	.613	.749
ARSI	.733	.302	.088	.136	.386	.584	.649	.711	.747	.578	.634
ARAI	1.000	.387	.106	.176	.328	.592	.661	.755	.749	.527	.595
ARCM	.387	1.000	-.033	.408	.258	.288	.138	.436	.256	.123	.060
ARCA	.106	-.033	1.000	.344	.088	.194	.364	.187	.260	.466	.430
ARCE	.176	.408	.344	1.000	.103	.315	.346	.349	.266	.300	.193
ARCC	.328	.258	.088	.103	1.000	.363	.347	.354	.416	.287	.324
DRCO	.592	.288	.194	.315	.363	1.000	.776	.797	.756	.770	.692
DRFA	.661	.138	.364	.346	.347	.776	1.000	.886	.901	.837	.856
DRMM	.755	.436	.187	.349	.354	.797	.886	1.000	.878	.707	.735
DRGM	.749	.256	.260	.266	.416	.756	.901	.878	1.000	.792	.867
DRCL	.527	.123	.466	.300	.287	.770	.837	.707	.792	1.000	.929
DRGT	.595	.060	.430	.193	.324	.692	.856	.735	.867	.929	1.000
DREL	.651	.176	.303	.332	.300	.765	.977	.894	.925	.805	.853
DRSC	.658	.094	.340	.255	.354	.771	.912	.835	.935	.849	.929
DRST	.626	.103	.305	.254	.320	.772	.950	.815	.910	.823	.864
DROF	.775	.278	.284	.304	.481	.696	.879	.858	.901	.776	.791
DRGCT	.631	.074	.356	.249	.308	.768	.910	.816	.898	.875	.948
WRSTAND	.467	.076	.225	.160	.175	.520	.705	.616	.689	.607	.686
HOCST	.525	-.172	.283	-.005	.253	.589	.621	.500	.616	.620	.678
PROFICST	.607	.000	.277	.103	.217	.668	.811	.719	.778	.714	.786
FCGST	.532	.100	.188	.124	.119	.569	.717	.694	.654	.571	.616
HOCTOTST	.573	-.059	.293	.086	.248	.641	.762	.641	.751	.707	.786

TABLE C-4 (Cont'd)

	DREL	DRSC	DRST	DROF	DRGCT	WRSTAND	HOCST	PROFICST	FCGST	HOCTOTST
ARGI	.742	.706	.713	.745	.693	.614	.470	.668	.599	.622
ARNO	.656	.562	.711	.506	.546	.570	.405	.625	.601	.559
ARAD	.191	.233	.282	.138	.231	.261	.357	.334	.223	.357
ARWK	.796	.890	.795	.800	.883	.714	.650	.762	.558	.785
ARAR	.860	.830	.883	.707	.839	.684	.677	.824	.712	.784
ARSP	.576	.695	.559	.579	.657	.346	.662	.579	.443	.586
ARMK	.830	.727	.872	.616	.750	.670	.620	.781	.676	.742
AREI	.783	.784	.722	.746	.750	.666	.575	.749	.645	.714
ARMC	.768	.792	.760	.687	.774	.619	.530	.676	.556	.660
ARGS	.746	.796	.778	.698	.766	.727	.603	.723	.497	.764
ARSI	.653	.692	.659	.713	.649	.621	.432	.600	.463	.604
ARAI	.651	.658	.626	.775	.631	.467	.525	.607	.532	.573
ARCM	.176	.094	.103	.278	.074	.076	-.172	.000	.100	-.059
ARCA	.303	.340	.305	.284	.356	.225	.283	.277	.188	.293
ARCE	.332	.255	.254	.304	.249	.160	-.005	.109	.124	.086
ARCC	.300	.354	.320	.481	.308	.175	.253	.217	.119	.248
DRCO	.765	.771	.772	.696	.768	.520	.589	.668	.569	.641
DRFA	.977	.912	.950	.879	.910	.705	.621	.811	.717	.762
DRMM	.894	.835	.815	.858	.816	.616	.500	.719	.694	.641
DRGM	.925	.935	.910	.901	.898	.689	.616	.778	.654	.751
DRCL	.805	.849	.823	.776	.875	.607	.620	.714	.571	.707
DRGT	.853	.929	.864	.791	.948	.686	.678	.786	.616	.786
DREL	1.000	.916	.970	.824	.913	.731	.587	.821	.751	.757
DRSC	.916	1.000	.903	.840	.987	.714	.716	.832	.664	.824
DRST	.970	.903	1.000	.786	.905	.750	.623	.832	.725	.789
DROF	.824	.840	.786	1.000	.809	.584	.560	.681	.570	.659
DRGCT	.913	.987	.905	.809	1.000	.719	.714	.844	.691	.826
WRSTAND	.731	.714	.750	.584	.719	1.000	.506	.846	.641	.859
HOCST	.587	.716	.623	.560	.714	.506	1.000	.809	.523	.876
PROFICST	.921	.832	.832	.681	.844	.846	.809	1.000	.862	.953
FCGST	.751	.664	.725	.570	.691	.641	.523	.862	1.000	.668
HOCTOTST	.757	.824	.789	.659	.826	.859	.876	.953	.668	1.000

TABLE C-5

INTERCORRELATION MATRICES FOR FINAL SAMPLE
AUTOMOTIVE MECHANIC

Part A: Uncorrected Intercorrelation Matrix

	Mean	Standard deviation
ARGI	9.634	2.684
ARNO	30.153	8.603
ARAO	14.008	3.551
ARWK	18.122	4.963
ARAR	11.733	3.444
ARSP	13.603	3.592
ARMK	11.191	3.855
AREI	19.298	4.444
ARMC	10.886	3.403
ARGS	10.496	3.257
ARSI	14.008	3.792
ARAI	12.267	4.804
ARCM	13.786	3.827
ARCA	9.924	2.916
ARCE	9.061	4.066
ARCC	18.908	3.902
ORCO	71.412	11.923
ORFA	59.870	11.694
ORMM	69.527	16.702
ORGM	45.389	11.804
ORCL	54.443	8.980
ORGT	29.931	6.747
OREL	51.122	11.538
ORSC	54.954	9.755
ORST	32.496	7.997
OROF	31.595	7.486
ORGCT	43.916	7.478
WRSTAND	50.235	9.933
HOCEFFST	49.620	9.985
PROFICST	50.247	10.327
FCGSTAND	50.709	10.016
PROFIC2S	49.973	9.983
WRFCG	100.944	17.568

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TABLE C-5 (Cont'd)

Variable	Description
ARGI	General Information subtest raw score, tested at AFEES[a]
ARNO	Numerical Operations subtest raw score, tested at AFEES
ARAD	Attention to Detail subtest raw score, tested at AFEES
ARWK	Word Knowledge subtest raw score, tested at AFEES
ARAR	Arithmetic Reasoning subtest raw score, tested at AFEES
ARSP	Space Perception subtest raw score, tested at AFEES
ARMK	Mathematics Knowledge subtest raw score, tested at AFEES
AREI	Electronics Information subtest raw score, tested at AFEES
ARMC	Mechanical Comprehension subtest raw score, tested at AFEES
ARGS	General Science subtest raw score, tested at AFEES
ARSI	Shop Information subtest raw score, tested at AFEES
ARAI	Automotive Information subtest raw score, tested at AFEES
ARCM	Mechanical Interest subtest raw score, tested at AFEES
ARCA	Attentiveness Interest subtest raw score, tested at AFEES
ARCE	Electronics Interest subtest raw score, tested at AFEES
ARCC	Combat Interest subtest raw score, tested at AFEES
DRCO	Combat aptitude composite raw score, tested at Depot
DRFA	Field Artillery composite raw score, tested at Depot
DRMM	Mechanical Maintenance composite raw score, tested at Depot
DRGM	General Maintenance composite raw score, tested at Depot
DRCL	Clerical composite raw score, tested at Depot
DRGT	General Technical composite raw score, tested at Depot
DREL	Electronics Repair composite raw score, tested at Depot
DRSC	Surveillance/Communications composite raw score, tested at Depot
DRST	Skilled Technical composite raw score, tested at Depot
DROF	Operators/Food composite raw score, tested at Depot
DRGCT	AFQT raw score, tested at Depot
WRSTAND	Written test, standardized
HOC	Hands-on test, standardized
HOCEFFST	Hands-on efficiency, standardized
PROFICST	WRSTAND plus FCGSTAND plus HOCEFFST, standardized
FCGSTAND	Final course grade (training), standardized
PROFIC2S	WRSTAND plus HOCEFFST, standardized
WRFCG	WRSTAND plus FCGSTAND

[a]Forms 6 and 7 of the ASVAB.

TABLE C-5 (Cont'd)

	ARGI	ARNO	ARAD	ARWK	ARAR	ARSP	ARMK	AREI	ARMC	ARGS	ARSI
ARGI	1.000	.215	.088	.434	.192	.029	.193	.492	.368	.494	.452
ARNO	.215	1.000	.270	.069	.187	-.053	.381	.199	.098	.198	.094
ARAD	.088	.270	1.000	-.107	.071	.053	.339	-.079	.008	-.015	.101
ARWK	.434	.069	-.107	1.000	.237	.003	.134	.419	.261	.472	.355
ARAR	.192	.187	.071	.237	1.000	.080	.425	.216	.436	.351	.334
ARSP	.029	-.053	.053	.003	.080	1.000	.134	.088	.313	.026	.050
ARMK	.193	.381	.339	.134	.425	.134	1.000	.111	.263	.193	.038
AREI	.492	.199	-.079	.419	.216	.088	.111	1.000	.448	.498	.551
ARMC	.368	.098	.008	.261	.436	.313	.263	.448	1.000	.401	.490
ARGS	.494	.198	-.015	.472	.351	.026	.193	.498	.401	1.000	.405
ARSI	.452	.094	.101	.355	.334	.050	.038	.551	.490	.405	1.000
ARAI	.541	.139	.059	.375	.350	.055	.156	.563	.488	.409	.641
ARCM	.359	.240	.110	.214	.108	.097	.092	.345	.410	.296	.471
ARCA	-.080	.029	-.001	-.042	-.058	-.084	-.006	-.100	-.224	.009	-.312
ARCE	.009	.118	.084	-.091	-.193	.077	.127	.008	-.062	-.080	-.254
ARCC	.317	.099	-.014	.291	.204	-.241	.067	.284	.108	.362	.230
DRCO	.472	.283	.296	.227	.471	.216	.387	.373	.560	.390	.465
DRFA	.582	.297	.159	.415	.533	.008	.528	.540	.530	.507	.500
DRMM	.560	.249	.094	.414	.414	.070	.345	.671	.627	.485	.716
DRGM	.562	.236	.112	.399	.530	.126	.364	.615	.617	.562	.650
DRCL	.499	.309	.328	.375	.424	-.048	.389	.286	.346	.420	.324
DRGT	.544	.240	.109	.576	.503	-.007	.353	.440	.404	.521	.452
DREL	.550	.313	.154	.447	.541	.067	.530	.609	.559	.568	.549
DRSC	.549	.201	.110	.469	.552	.249	.371	.500	.549	.546	.502
DRST	.486	.333	.222	.344	.574	.068	.605	.402	.470	.500	.394
DROF	.559	.129	.038	.378	.346	.007	.216	.538	.535	.415	.574
DRGCT	.516	.164	.092	.508	.517	.242	.347	.413	.484	.478	.413
WRSTAND	.280	.079	.012	.354	.189	.200	.149	.352	.335	.329	.268
HOCEFFST	.298	.096	.088	.148	.109	.125	.102	.297	.328	.120	.397
PROFICST	.442	.150	.075	.369	.280	.170	.238	.523	.500	.374	.508
FCGSTAND	.469	.191	.076	.373	.366	.078	.313	.590	.522	.437	.537
PROFIC2S	.352	.100	.061	.305	.181	.198	.153	.394	.403	.273	.405
WRFCG	.426	.154	.050	.413	.315	.157	.263	.535	.487	.436	.458

TABLE C-5 (Cont'd)

	ARAI	ARCM	ARCA	ARCE	ARCC	DRCO	DRFA	DRMM	DRGM	DRCL	DRGT
ARGI	.541	.358	-.080	.009	.317	.472	.582	.560	.562	.499	.544
ARNO	.139	.240	.029	.118	.099	.283	.297	.249	.236	.309	.240
ARAD	.059	.110	-.001	.084	-.014	.296	.159	.094	.112	.328	.109
ARWK	.375	.214	-.042	-.091	.291	.227	.415	.414	.399	.375	.576
ARAR	.350	.108	-.058	-.193	.204	.471	.533	.414	.530	.424	.503
ARSP	.055	.097	-.084	.077	-.241	.216	.008	.070	.126	-.048	-.007
ARMK	.156	.092	-.006	.127	.067	.387	.528	.345	.364	.389	.353
AREI	.563	.345	-.100	.008	.284	.373	.540	.671	.615	.286	.440
ARMC	.488	.410	-.224	-.062	.108	.560	.530	.627	.617	.346	.404
ARGS	.409	.296	.009	-.080	.362	.390	.507	.485	.562	.420	.521
ARSI	.641	.471	-.312	-.254	.230	.465	.500	.716	.650	.324	.452
ARAI	1.000	.530	-.289	-.121	.257	.488	.544	.742	.720	.404	.464
ARCM	.530	1.000	-.095	.228	.230	.386	.366	.574	.457	.279	.295
ARCA	-.289	-.095	1.000	.344	.242	-.109	-.029	-.232	-.163	.058	-.042
ARCE	-.121	.228	.344	1.000	.134	-.004	.049	-.013	-.121	-.029	-.185
ARCC	.257	.230	.242	.134	1.000	.323	.351	.309	.288	.292	.281
DRCO	.498	.386	-.109	-.004	.323	1.000	.705	.710	.734	.738	.528
DRFA	.544	.366	-.029	.049	.351	.705	1.000	.817	.797	.736	.743
DRMM	.742	.574	-.232	-.013	.309	.710	.817	1.000	.883	.546	.604
DRGM	.720	.457	-.163	-.121	.288	.734	.797	.883	1.000	.628	.697
DRCL	.404	.279	.058	-.029	.292	.738	.736	.546	.628	1.000	.800
DRGT	.464	.295	-.042	-.185	.281	.528	.743	.604	.697	.800	1.000
DREL	.549	.344	-.070	-.030	.304	.684	.941	.833	.856	.664	.753
DRSC	.498	.344	-.069	-.128	.217	.704	.781	.704	.832	.721	.861
DRST	.405	.269	-.042	-.057	.251	.682	.868	.679	.778	.680	.739
DROF	.744	.497	-.128	.005	.321	.608	.725	.834	.829	.571	.543
DRGCT	.422	.292	-.045	-.134	.181	.622	.724	.587	.707	.728	.909
WRSTAND	.414	.229	-.181	-.088	.004	.338	.365	.494	.496	.230	.324
HOCEFFST	.497	.307	-.139	.014	-.082	.316	.303	.486	.446	.234	.234
PROFICST	.643	.397	-.191	-.049	.039	.475	.553	.721	.705	.392	.481
FCGSTAND	.612	.405	-.132	-.042	.169	.471	.642	.729	.728	.465	.581
PROFIC2S	.554	.326	-.195	-.045	-.048	.397	.406	.596	.573	.282	.339
WRFCG	.583	.360	-.178	-.074	.099	.460	.572	.695	.695	.395	.515

TABLE C-5 (Cont'd)

	DREL	DRSC	DRST	DROF	DRGCT	WRSTAND	HOCEFFST	PROFICST	FCGSTAND	PROFIC2S	WRFCG
ARGI	.550	.549	.486	.559	.516	.280	.298	.442	.469	.352	.426
ARNO	.313	.201	.333	.129	.164	.079	.086	.150	.191	.100	.154
ARAD	.154	.110	.222	.038	.092	.012	.088	.075	.076	.061	.050
ARWK	.447	.469	.344	.378	.508	.354	.148	.369	.373	.305	.413
ARAR	.541	.552	.574	.346	.517	.189	.109	.280	.366	.181	.315
ARSP	.067	.249	.068	.007	.242	.200	.125	.170	.078	.198	.157
ARMK	.530	.371	.605	.216	.347	.149	.102	.238	.313	.153	.263
AREI	.609	.500	.402	.538	.413	.352	.297	.523	.590	.394	.535
ARMC	.559	.549	.470	.535	.484	.335	.328	.500	.522	.403	.487
ARGS	.568	.546	.500	.415	.478	.329	.120	.374	.437	.273	.436
ARSI	.549	.502	.394	.574	.413	.268	.397	.508	.537	.405	.458
ARAI	.549	.498	.405	.744	.422	.414	.497	.643	.612	.554	.583
ARCM	.344	.344	.269	.497	.292	.229	.307	.397	.405	.326	.360
ARCA	-.070	-.069	-.042	-.128	-.045	-.181	-.139	-.191	-.132	-.195	-.178
ARCE	-.030	-.128	-.057	.005	-.134	-.088	.014	-.049	-.042	-.045	-.074
ARCC	.304	.217	.251	.321	.181	.004	-.082	.039	.169	-.048	.099
DRCO	.684	.704	.682	.608	.622	.338	.316	.475	.471	.397	.460
DRFA	.941	.781	.868	.725	.724	.365	.303	.553	.642	.406	.572
DRMM	.833	.704	.679	.834	.587	.494	.486	.721	.729	.596	.695
DRGM	.856	.832	.778	.829	.707	.496	.446	.705	.728	.573	.695
DRCL	.664	.721	.680	.571	.728	.230	.234	.392	.465	.282	.395
DRGT	.753	.861	.739	.543	.909	.324	.234	.481	.581	.339	.515
DREL	1.000	.798	.922	.632	.737	.436	.330	.611	.681	.466	.635
DRSC	.798	1.000	.755	.629	.951	.404	.309	.554	.599	.433	.570
DRST	.922	.755	1.000	.515	.729	.379	.226	.493	.564	.367	.536
DROF	.632	.629	.515	1.000	.537	.405	.454	.636	.648	.523	.598
DRGCT	.737	.951	.729	.537	1.000	.347	.257	.478	.528	.367	.497
WRSTAND	.436	.404	.379	.405	.347	1.000	.351	.802	.551	.821	.880
HOCEFFST	.330	.309	.226	.454	.257	.351	1.000	.742	.406	.823	.430
PROFICST	.611	.554	.493	.636	.478	.802	.742	1.000	.826	.939	.924
FCGSTAND	.681	.599	.564	.648	.528	.551	.406	.826	1.000	.582	.882
PROFIC2S	.466	.433	.367	.523	.367	.821	.823	.939	.582	1.000	.796
WRFCG	.635	.570	.536	.598	.497	.880	.430	.924	.882	.796	1.000

TABLE C-5 (Cont'd)

Part B: Corrected Intercorrelation Matrix

	Mean	Standard deviation
ARGI	9.634	3.200
ARNO	30.153	10.500
ARAD	14.008	4.000
ARWK	18.122	7.000
ARAR	11.733	4.700
ARSP	13.603	4.200
ARMK	11.191	4.900
AREI	19.298	5.700
ARMC	10.886	4.500
ARGS	10.496	4.300
ARSI	14.008	4.200
ARAI	12.267	4.800
ARCM	13.786	4.200
ARCA	9.924	3.000
ARCE	9.061	4.600
ARCC	18.908	3.800
ORCO	71.412	15.650
ORFA	59.870	16.831
ORMM	69.527	20.920
ORGM	45.389	15.780
ORCL	54.443	11.646
ORGT	29.931	9.322
OREL	51.122	17.512
ORSC	54.954	14.538
ORST	32.496	11.424
OROF	31.595	8.441
ORGCT	43.916	10.958
WRSTAND	50.235	11.293
HOCEFFST	49.620	10.567
PROFICST	50.247	12.647
FCGSTAND	50.709	12.662
PROFIC2S	49.973	11.334
WRFCG	100.944	21.999

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TABLE C-5 (Cont'd)

	ARGI	ARNO	ARAD	ARWK	ARAR	ARSP	ARMK	AREI	ARMC	ARGS	ARSI
ARGI	1.000	.492	.196	.728	.608	.446	.557	.657	.598	.664	.614
ARNO	.492	1.000	.424	.495	.631	.417	.633	.452	.476	.490	.426
ARAD	.196	.424	1.000	.186	.291	.285	.270	.196	.229	.186	.209
ARWK	.728	.495	.186	1.000	.725	.504	.658	.720	.664	.795	.642
ARAR	.608	.631	.291	.725	1.000	.575	.781	.635	.690	.693	.569
ARSP	.446	.417	.285	.504	.575	1.000	.515	.534	.620	.500	.513
ARMK	.557	.633	.270	.658	.781	.515	1.000	.592	.625	.672	.472
AREI	.657	.452	.196	.720	.635	.534	.592	1.000	.707	.699	.708
ARMC	.598	.476	.229	.664	.690	.620	.625	.707	1.000	.699	.671
ARGS	.664	.490	.186	.795	.693	.500	.672	.699	.699	1.000	.642
ARSI	.614	.426	.209	.642	.569	.513	.472	.708	.671	.642	1.000
ARAI	.596	.397	.142	.594	.549	.461	.465	.712	.669	.606	.733
ARCM	.143	.028	.028	.059	.070	.135	.016	.262	.229	.095	.302
ARCA	.186	.247	.140	.284	.275	.184	.273	.177	.149	.236	.088
ARCE	.120	.181	.122	.140	.212	.214	.241	.255	.222	.208	.136
ARCC	.369	.236	.121	.332	.283	.261	.227	.323	.337	.332	.386
ORCO	.653	.592	.413	.631	.720	.628	.648	.646	.748	.643	.652
ORFA	.743	.593	.265	.779	.805	.530	.793	.772	.759	.766	.692
ORMM	.681	.509	.205	.712	.694	.536	.670	.824	.789	.717	.803
ORGM	.715	.558	.253	.754	.772	.590	.716	.801	.794	.775	.764
ORCL	.683	.597	.428	.709	.718	.449	.661	.594	.633	.666	.546
ORGT	.743	.562	.271	.823	.775	.489	.706	.695	.666	.741	.625
OREL	.730	.608	.277	.804	.814	.568	.808	.805	.776	.803	.718
ORSC	.748	.569	.287	.804	.814	.637	.732	.751	.751	.773	.683
ORST	.709	.620	.302	.755	.819	.541	.821	.703	.716	.761	.625
OROF	.644	.395	.139	.631	.590	.433	.536	.703	.704	.623	.688
ORGCT	.739	.547	.278	.807	.797	.612	.709	.705	.712	.736	.629
WRSTAND	.472	.346	.162	.585	.501	.446	.471	.568	.547	.570	.464
HOCEFFST	.381	.279	.128	.374	.341	.316	.324	.451	.452	.358	.493
PROFICST	.598	.442	.199	.666	.610	.502	.584	.722	.690	.654	.657
FCGSTAND	.629	.470	.203	.691	.664	.486	.645	.768	.714	.687	.678
PROFIC2S	.503	.368	.172	.568	.498	.451	.470	.601	.589	.550	.562
WRFCG	.605	.448	.200	.698	.639	.509	.613	.734	.692	.688	.628

TABLE C-5 (Cont'd)

	ARAI	ARCM	ARCA	ARCE	ARCC	DRCO	DRFA	DRMM	DRGM	DRCL	DRGT
ARGI	.596	.143	.186	.120	.368	.653	.743	.681	.715	.683	.743
ARNO	.397	.028	.247	.181	.236	.592	.593	.509	.558	.597	.562
ARAD	.142	.028	.140	.122	.121	.413	.265	.205	.253	.428	.271
ARWK	.594	.059	.284	.140	.332	.631	.779	.712	.754	.709	.823
ARAR	.549	.070	.275	.212	.283	.720	.805	.694	.772	.718	.775
ARSP	.461	.135	.184	.214	.261	.628	.530	.536	.590	.449	.489
ARMK	.465	.016	.273	.241	.227	.648	.793	.670	.716	.661	.706
AREI	.712	.262	.177	.255	.323	.646	.772	.824	.801	.594	.695
ARMC	.669	.229	.149	.222	.337	.748	.759	.789	.794	.633	.666
ARGS	.606	.095	.236	.208	.332	.643	.766	.717	.775	.666	.741
ARSI	.733	.302	.088	.136	.386	.652	.692	.803	.764	.546	.625
ARAI	1.000	.387	.106	.176	.328	.617	.668	.796	.777	.546	.590
ARCM	.387	1.000	-.033	.408	.258	.221	.181	.385	.244	.098	.105
ARCA	.106	-.033	1.000	.344	.088	.181	.291	.152	.225	.318	.269
ARCE	.176	.408	.344	1.000	.103	.211	.289	.294	.208	.164	.093
ARCC	.328	.258	.088	.103	1.000	.462	.360	.393	.364	.319	.317
DRCO	.617	.221	.181	.211	.462	1.000	.816	.811	.836	.835	.722
DRFA	.668	.181	.291	.289	.360	.816	1.000	.892	.899	.841	.869
DRMM	.796	.385	.152	.294	.393	.811	.892	1.000	.927	.703	.751
DRGM	.777	.244	.225	.208	.364	.836	.899	.927	1.000	.782	.832
DRCL	.546	.098	.318	.164	.319	.835	.841	.703	.782	1.000	.886
DRGT	.590	.105	.269	.093	.317	.722	.869	.751	.832	.886	1.000
DREL	.675	.144	.278	.244	.340	.809	.973	.897	.929	.809	.876
DRSC	.642	.157	.274	.176	.332	.830	.905	.831	.916	.853	.934
DRST	.581	.101	.266	.192	.320	.805	.936	.815	.890	.817	.875
DROF	.787	.356	.199	.268	.358	.712	.803	.876	.868	.684	.673
DRGCT	.592	.128	.280	.147	.307	.787	.877	.767	.855	.859	.960
WRSTAND	.546	.126	.109	.112	.143	.539	.592	.646	.660	.479	.546
HOCEFFST	.568	.207	.187	.223	.013	.421	.453	.560	.537	.385	.388
PROFICST	.730	.232	.210	.230	.168	.649	.744	.817	.819	.617	.680
FCGSTAND	.709	.245	.226	.240	.246	.654	.796	.826	.835	.663	.746
PROFIC2S	.654	.194	.173	.194	.094	.566	.617	.711	.707	.510	.552
WRFCG	.688	.206	.186	.196	.215	.653	.762	.807	.820	.627	.709

TABLE C-5 (Cont'd)

	DREL	DRSC	DRST	DROF	DRGCT	WRSTAND	HOCEFFST	PROFICST	FCGSTAND	PROFIC2S	WRFCG
ARGI	.730	.748	.709	.644	.739	.472	.381	.598	.629	.503	.605
ARNO	.608	.569	.620	.395	.547	.346	.279	.442	.470	.368	.448
ARAD	.277	.287	.302	.139	.278	.162	.128	.199	.203	.172	.200
ARWK	.804	.804	.755	.631	.807	.585	.374	.666	.691	.568	.698
ARAR	.814	.814	.819	.590	.797	.501	.341	.610	.664	.498	.639
ARSP	.568	.637	.541	.433	.612	.446	.316	.502	.486	.451	.509
ARMK	.808	.732	.821	.536	.709	.471	.324	.584	.645	.470	.613
AREI	.805	.751	.703	.703	.705	.568	.451	.722	.768	.601	.734
ARMC	.776	.751	.716	.704	.712	.547	.452	.690	.714	.589	.692
ARGS	.803	.773	.761	.623	.736	.570	.358	.654	.687	.550	.688
ARSI	.718	.683	.625	.688	.629	.464	.493	.657	.678	.562	.628
ARAI	.675	.642	.581	.787	.592	.546	.568	.730	.709	.654	.688
ARCM	.144	.157	.101	.356	.128	.126	.207	.232	.245	.194	.206
ARCA	.278	.274	.266	.199	.280	.109	.187	.210	.226	.173	.186
ARCE	.244	.176	.192	.268	.147	.112	.223	.230	.240	.194	.196
ARCC	.340	.332	.320	.358	.307	.143	.013	.168	.246	.094	.215
DRCO	.809	.830	.805	.712	.787	.539	.421	.649	.654	.566	.653
DRFA	.973	.905	.936	.803	.877	.592	.453	.744	.796	.617	.762
DRMM	.897	.831	.815	.876	.767	.646	.560	.817	.826	.711	.807
DRGM	.929	.916	.890	.868	.855	.660	.537	.819	.835	.707	.820
DRCL	.809	.853	.817	.684	.859	.479	.385	.617	.663	.510	.627
DRGT	.876	.934	.875	.673	.960	.546	.388	.680	.746	.552	.709
DREL	1.000	.913	.963	.746	.884	.634	.471	.776	.817	.653	.796
DRSC	.913	1.000	.892	.747	.978	.602	.445	.734	.770	.619	.752
DRST	.963	.892	1.000	.677	.880	.600	.395	.707	.751	.589	.740
DROF	.746	.747	.677	1.000	.693	.560	.540	.744	.751	.647	.720
DRGCT	.884	.978	.880	.693	1.000	.563	.408	.688	.731	.574	.709
WRSTAND	.634	.602	.600	.560	.563	1.000	.446	.852	.686	.861	.908
HOCEFFST	.471	.445	.395	.540	.408	.446	1.000	.762	.511	.839	.523
PROFICST	.776	.734	.707	.744	.688	.852	.762	1.000	.891	.951	.950
FCGSTAND	.817	.770	.751	.751	.731	.686	.511	.891	1.000	.707	.928
PROFIC2S	.653	.619	.589	.647	.574	.861	.839	.951	.707	1.000	.849
WRFCG	.796	.752	.740	.720	.709	.908	.523	.950	.928	.849	1.000

TABLE C-6

INTERCORRELATION MATRICES FOR INFANTRY RIFLEMAN
TESTED WITH ASVAB 6/7

Part A: Uncorrected Intercorrelation Matrix

	Mean	Standard deviation
ARGI	9.107	2.797
ARNO	29.979	8.411
ARAO	15.164	3.547
ARWK	17.900	4.352
ARAR	11.207	3.213
ARSP	12.807	3.662
ARMK	10.100	4.044
AREI	17.421	4.655
ARMC	9.736	3.459
ARGS	9.850	3.476
ARSI	13.100	3.659
ARAI	10.386	3.932
ARCM	12.036	4.120
ARCA	9.521	2.930
ARCE	8.186	4.223
ARCC	18.886	3.575
ORCO	69.336	10.439
ORFA	54.150	11.904
ORMM	59.750	14.936
ORGM	40.750	11.148
ORCL	53.100	9.214
ORGT	27.843	7.524
OREL	46.171	12.005
ORSC	50.493	11.071
ORST	29.743	8.876
OROF	28.093	6.776
ORGCT	40.764	8.983
WRSTAND	49.670	8.809
HOSTAND	49.625	9.849
TESTSCOR	99.294	15.803

N OF CASES = 140

TABLE C-6 (Cont'd)

Variable	Description
ARGI	General Information subtest raw score, tested at AFEES[a]
ARNO	Numerical Operations subtest raw score, tested at AFEES
ARAD	Attention to Detail subtest raw score, tested at AFEES
ARWK	Word Knowledge subtest raw score, tested at AFEES
ARAR	Arithmetic Reasoning subtest raw score, tested at AFEES
ARSP	Space Perception subtest raw score, tested at AFEES
ARMK	Mathematics Knowledge subtest raw score, tested at AFEES
AREI	Electronics Information subtest raw score, tested at AFEES
ARMC	Mechanical Comprehension subtest raw score, tested at AFEES
ARGS	General Science subtest raw score, tested at AFEES
ARSI	Shop Information subtest raw score, tested at AFEES
ARAI	Automotive Information subtest raw score, tested at AFEES
ARCM	Mechanical Interest subtest raw score, tested at AFEES
ARCA	Attentiveness Interest subtest raw score, tested at AFEES
ARCE	Electronics Interest subtest raw score, tested at AFEES
ARCC	Combat Interest subtest raw score, tested at AFEES
DRCO	Combat aptitude composite raw score, tested at Depot
DRFA	Field Artillery composite raw score, tested at Depot
DRMM	Mechanical Maintenance composite raw score, tested at Depot
DRGM	General Maintenance composite raw score, tested at Depot
DRCL	Clerical composite raw score, tested at Depot
DRGT	General Technical composite raw score, tested at Depot
DREL	Electronics Repair composite raw score, tested at Depot
DRSC	Surveillance/Communications composite raw score, tested at Depot
DRST	Skilled Technical composite raw score, tested at Depot
DROF	Operators/Food composite raw score, tested at Depot
DRGCT	AFQT raw score tested at Depot
WRSTAND	Written test, standardized
HOSTAND	Hands-on test, standardized
TESTSCOR	WRSTAND plus HOSTAND

[a]Forms 6 and 7 of the ASVAB.

TABLE C-6 (Cont'd)

	ARGI	ARNO	ARAD	ARWK	ARAR	ARSP	ARMK	AREI	ARMC	ARGS	ARSI
ARGI	1.000	.151	-.021	.481	.331	.017	.330	.498	.350	.349	.509
ARNO	.151	1.000	.326	.073	.259	.097	.499	.038	-.007	.202	-.006
ARAD	-.021	.326	1.000	-.049	.126	.129	.161	-.063	.055	.102	.046
ARWK	.481	.073	-.049	1.000	.379	.039	.317	.398	.393	.515	.397
ARAR	.331	.259	.126	.379	1.000	.145	.435	.281	.249	.324	.269
ARSP	.017	.097	.129	.039	.145	1.000	.326	.139	.359	.214	.216
ARMK	.330	.499	.161	.317	.435	.326	1.000	.256	.295	.398	.172
AREI	.498	.038	-.063	.398	.281	.139	.256	1.000	.508	.457	.554
ARMC	.350	-.007	.055	.393	.249	.359	.295	.508	1.000	.567	.621
ARGS	.349	.202	.102	.515	.324	.214	.398	.457	.567	1.000	.513
ARSI	.509	-.006	.046	.397	.269	.216	.172	.554	.621	.513	1.000
ARAI	.490	.121	-.110	.314	.268	.141	.129	.590	.472	.377	.559
ARCM	.118	.012	-.143	-.004	-.025	-.144	-.094	.335	.082	.035	.217
ARCA	-.118	.277	.114	-.189	-.108	-.004	.059	-.113	-.184	-.074	-.251
ARCE	-.138	.018	-.048	-.121	-.083	.007	.063	.070	-.038	.004	-.046
ARCC	.263	.039	.023	.300	.189	.121	.218	.245	.258	.151	.283
DRCO	.299	.299	.237	.321	.358	.393	.447	.378	.478	.340	.379
DRFA	.562	.374	.141	.481	.486	.243	.607	.589	.427	.560	.441
DRMM	.551	.216	.002	.409	.316	.188	.362	.691	.545	.505	.643
DRGM	.554	.235	.036	.500	.514	.264	.481	.615	.573	.552	.597
DRCL	.395	.421	.330	.504	.415	.149	.541	.341	.314	.428	.259
DRGT	.516	.261	.048	.700	.530	.175	.481	.418	.437	.573	.439
DREL	.547	.330	.122	.509	.502	.284	.603	.598	.476	.605	.502
DRSC	.484	.222	.088	.611	.527	.435	.539	.504	.605	.559	.499
DRST	.447	.414	.155	.496	.555	.289	.662	.422	.359	.533	.346
DROF	.556	.259	.033	.429	.300	.051	.342	.575	.432	.447	.495
DRGCT	.445	.230	.087	.642	.510	.383	.513	.430	.524	.551	.434
WRSTAND	.449	.263	-.017	.381	.325	.233	.449	.312	.344	.432	.392
HOSTAND	.260	.068	.010	.323	.282	.220	.322	.298	.404	.375	.305
TESTSCOR	.413	.189	-.003	.414	.357	.267	.451	.360	.443	.474	.409

TABLE C-6 (Cont'd)

	ARAI	ARCM	ARCA	ARCE	ARCC	DRCO	DRFA	DRMM	DRGM	DRCL	DRGT
ARGI	.490	.118	-.118	-.138	.263	.299	.562	.551	.554	.395	.516
ARND	.121	.012	.277	.018	.099	.299	.374	.216	.235	.421	.261
ARAD	-.110	-.143	.114	-.048	.023	.237	.141	.002	.036	.330	.048
ARWK	.314	-.004	-.189	-.121	.300	.321	.481	.409	.500	.504	.700
ARAR	.269	-.025	-.108	-.083	.189	.358	.486	.316	.514	.415	.530
ARSP	.141	-.144	-.004	.007	.121	.393	.243	.188	.264	.149	.175
ARMK	.129	-.094	.059	.063	.218	.447	.607	.362	.481	.541	.481
AREI	.590	.335	-.113	.070	.245	.378	.589	.691	.615	.341	.418
ARMC	.472	.082	-.184	-.038	.258	.478	.427	.545	.573	.314	.437
ARGS	.377	.035	-.074	.004	.151	.340	.560	.505	.552	.428	.573
ARSI	.559	.217	-.251	-.046	.283	.379	.441	.643	.597	.259	.439
ARAI	1.000	.345	-.162	-.005	.183	.299	.410	.655	.653	.234	.387
ARCM	.345	1.000	.006	.406	.207	.151	.189	.382	.293	.102	.107
ARCA	-.162	.006	1.000	.358	-.007	-.070	.007	-.162	-.142	.132	-.041
ARCE	-.005	.406	.358	1.000	.008	-.055	.040	-.005	.021	.036	.005
ARCC	.183	.207	-.007	.008	1.000	.462	.292	.333	.368	.352	.429
DRCO	.299	.151	-.070	-.055	.462	1.000	.637	.625	.621	.706	.539
DRFA	.410	.189	.007	.040	.292	.637	1.000	.779	.758	.718	.725
DRMM	.655	.382	-.162	-.005	.333	.625	.779	1.000	.813	.466	.542
DRGM	.653	.293	-.142	.021	.368	.621	.758	.813	1.000	.570	.721
DRCL	.234	.102	.132	.036	.352	.706	.718	.466	.570	1.000	.780
DRGT	.387	.107	-.041	.005	.429	.539	.725	.542	.721	.780	1.000
DREL	.446	.194	-.088	.024	.313	.655	.947	.783	.835	.705	.778
DRSC	.463	.118	-.083	.032	.451	.716	.750	.667	.825	.687	.864
DRST	.317	.107	-.030	.052	.295	.601	.855	.587	.781	.723	.782
DROF	.624	.297	.005	-.011	.225	.449	.694	.802	.737	.449	.473
DRGCT	.380	.077	-.050	.026	.423	.686	.727	.584	.710	.724	.910
WRSTAND	.317	-.002	.049	.054	.242	.280	.519	.374	.515	.390	.575
HOSTAND	.248	.055	-.071	.072	.219	.308	.380	.406	.470	.242	.426
TESTSCOR	.331	.033	-.017	.075	.272	.348	.526	.462	.580	.368	.586

TABLE C-6 (Cont'd)

	DREL	DRSC	DRST	DROF	DRGCT	WRSTAND	HOSTAND	TESTSCOR
ARGI	.547	.484	.447	.556	.445	.449	.260	.413
ARNO	.330	.222	.414	.259	.230	.263	.068	.189
ARAO	.122	.088	.155	.033	.087	-.017	.010	-.003
ARWK	.509	.611	.496	.429	.642	.381	.323	.414
ARAR	.502	.527	.555	.300	.510	.325	.282	.357
ARSP	.284	.435	.289	.051	.383	.233	.220	.267
ARMK	.603	.539	.662	.342	.513	.449	.322	.451
AREI	.598	.504	.422	.575	.430	.312	.298	.360
ARMC	.476	.605	.359	.432	.524	.344	.404	.443
ARGS	.605	.559	.533	.447	.551	.432	.375	.474
ARSI	.502	.499	.346	.495	.434	.392	.305	.409
ARAI	.446	.463	.317	.624	.380	.317	.248	.331
ARCM	.194	.118	.107	.297	.077	-.002	.055	.033
ARCA	-.088	-.083	-.030	.005	-.050	.049	-.071	-.017
ARCE	.024	.032	.052	-.011	.026	.054	.072	.075
ARCC	.313	.451	.295	.225	.423	.242	.219	.272
DRCO	.655	.716	.601	.449	.686	.280	.308	.348
DRFA	.947	.750	.855	.694	.727	.519	.380	.526
DRMM	.783	.667	.587	.802	.584	.374	.406	.462
DRGM	.835	.825	.781	.737	.710	.515	.470	.580
DRCL	.705	.687	.723	.449	.724	.390	.242	.368
DRGT	.778	.864	.782	.473	.910	.575	.426	.586
DREL	1.000	.798	.930	.583	.772	.524	.410	.548
DRSC	.798	1.000	.756	.554	.961	.537	.500	.611
DRST	.930	.756	1.000	.449	.749	.529	.366	.523
DROF	.583	.554	.449	1.000	.477	.418	.350	.451
DRGCT	.772	.961	.749	.477	1.000	.526	.467	.584
WRSTAND	.524	.537	.529	.418	.526	1.000	.433	.827
HOSTAND	.410	.500	.366	.350	.467	.433	1.000	.865
TESTSCOR	.548	.611	.523	.451	.584	.827	.865	1.000

TABLE C-6 (Cont'd)

Part B: Corrected Intercorrelation Matrix

	Mean	Standard deviation
ARGI	9.107	3.200
ARNO	29.979	10.500
ARAO	15.164	4.000
ARWK	17.900	7.000
ARAR	11.207	4.700
ARSP	12.807	4.200
ARMK	10.100	4.900
AREI	17.421	5.700
ARMC	9.736	4.500
ARGS	9.850	4.300
ARSI	13.100	4.200
ARAI	10.386	4.800
ARCM	12.086	4.200
ARCA	9.521	3.000
ARCE	8.186	4.600
ARCC	18.886	3.800
DRCO	69.336	13.514
DRFA	54.150	17.018
DRMM	59.750	18.633
DRGM	40.750	15.905
DRCL	53.100	13.291
DRGT	27.843	11.577
DREL	46.171	17.065
DRSC	50.493	17.568
DRST	29.743	12.939
DROF	28.093	8.695
DRGCT	40.764	14.205
WRSTAND	49.670	11.099
HOSTAND	49.625	11.607
TESTSCOR	99.294	20.389

N OF CASES = 140

TABLE C-6 (Cont'd)

	ARGI	ARND	ARAD	ARWK	ARAR	ARSP	ARMK	AREI	ARMC	ARGS	ARSI
ARGI	1.000	.492	.196	.728	.608	.446	.557	.657	.598	.664	.614
ARND	.492	1.000	.424	.495	.631	.417	.633	.452	.476	.490	.426
ARAD	.196	.424	1.000	.186	.291	.285	.270	.196	.229	.186	.209
ARWK	.729	.495	.186	1.000	.725	.504	.658	.720	.664	.795	.642
ARAR	.608	.631	.291	.725	1.000	.575	.781	.635	.690	.693	.569
ARSP	.446	.417	.285	.504	.575	1.000	.515	.534	.620	.500	.513
ARMK	.557	.633	.270	.658	.781	.515	1.000	.592	.625	.672	.472
AREI	.657	.452	.196	.720	.635	.534	.592	1.000	.707	.699	.708
ARMC	.598	.476	.229	.664	.690	.620	.625	.707	1.000	.699	.671
ARGS	.664	.490	.186	.795	.693	.500	.672	.699	.699	1.000	.642
ARSI	.614	.426	.209	.642	.569	.513	.472	.708	.671	.642	1.000
ARAI	.596	.397	.142	.594	.549	.461	.465	.712	.669	.606	.733
ARCM	.143	.028	.028	.059	.070	.135	.016	.262	.229	.095	.302
ARCA	.186	.247	.140	.284	.275	.184	.273	.177	.149	.236	.088
ARCE	.120	.181	.122	.140	.212	.214	.241	.255	.222	.208	.136
ARCC	.368	.236	.121	.332	.283	.261	.227	.323	.337	.332	.386
DRCO	.566	.578	.384	.618	.676	.635	.629	.635	.709	.593	.603
DRFA	.739	.629	.312	.786	.790	.596	.779	.778	.711	.780	.653
DRMM	.679	.527	.222	.682	.643	.539	.612	.796	.727	.696	.771
DRGM	.710	.561	.256	.766	.784	.609	.723	.780	.782	.765	.744
DRCL	.668	.631	.436	.785	.750	.534	.734	.666	.658	.713	.570
DRGT	.737	.578	.239	.875	.799	.565	.724	.707	.711	.810	.658
DREL	.729	.612	.299	.789	.793	.614	.777	.784	.727	.797	.684
DRSC	.722	.579	.286	.838	.820	.697	.748	.756	.803	.789	.688
DRST	.690	.648	.312	.784	.822	.608	.807	.708	.688	.771	.611
DROF	.689	.519	.236	.719	.644	.455	.621	.736	.677	.689	.687
DRGCT	.712	.573	.274	.854	.808	.667	.735	.725	.761	.790	.657
WRSTAND	.650	.528	.141	.681	.655	.502	.645	.592	.596	.678	.589
HOSTAND	.498	.376	.156	.576	.582	.467	.555	.538	.603	.590	.478
TESTSCOR	.638	.501	.165	.699	.688	.539	.667	.628	.668	.705	.593

TABLE C-6 (Cont'd)

	ARAI	ARCM	ARCA	ARCE	ARCC	DRCO	DRFA	DRMM	DRGM	DRCL	DRGT
ARGI	.596	.143	.186	.120	.368	.566	.739	.679	.710	.668	.737
ARNO	.397	.028	.247	.181	.236	.578	.629	.527	.561	.631	.578
ARAD	.142	.028	.140	.122	.121	.384	.312	.222	.256	.436	.239
ARWK	.534	.059	.284	.140	.332	.618	.786	.682	.766	.785	.875
ARAR	.549	.070	.275	.212	.283	.676	.790	.643	.784	.750	.799
ARSP	.461	.135	.184	.214	.261	.635	.596	.539	.609	.534	.565
ARMK	.465	.016	.273	.241	.227	.629	.779	.612	.723	.734	.724
AREI	.712	.262	.177	.255	.323	.635	.778	.796	.780	.666	.707
ARMC	.669	.229	.149	.222	.337	.709	.711	.727	.782	.658	.711
ARGS	.606	.095	.236	.208	.332	.593	.780	.696	.765	.713	.810
ARSI	.733	.302	.088	.136	.386	.603	.653	.771	.744	.570	.658
ARAI	1.000	.387	.106	.176	.328	.564	.628	.777	.782	.552	.630
ARCM	.387	1.000	-.033	.408	.258	.259	.201	.381	.316	.157	.155
ARCA	.106	-.033	1.000	.344	.088	.159	.284	.116	.204	.359	.313
ARCE	.176	.408	.344	1.000	.103	.175	.259	.195	.250	.248	.236
ARCC	.328	.258	.088	.103	1.000	.485	.353	.411	.418	.390	.444
DRCO	.564	.259	.159	.175	.485	1.000	.790	.782	.789	.826	.734
DRFA	.628	.201	.284	.259	.353	.790	1.000	.861	.878	.869	.880
DRMM	.777	.381	.116	.195	.411	.782	.861	1.000	.887	.706	.745
DRGM	.782	.316	.204	.250	.418	.789	.878	.887	1.000	.797	.866
DRCL	.552	.157	.359	.248	.390	.826	.869	.706	.797	1.000	.900
DRGT	.630	.155	.313	.236	.444	.734	.880	.745	.866	.900	1.000
DREL	.654	.220	.229	.253	.372	.800	.975	.866	.916	.863	.901
DRSC	.682	.211	.278	.275	.450	.831	.895	.817	.921	.866	.944
DRST	.587	.164	.264	.271	.351	.768	.934	.768	.896	.868	.902
DROF	.755	.285	.261	.180	.322	.673	.824	.874	.854	.707	.726
DRGCT	.637	.172	.302	.262	.434	.813	.887	.776	.870	.880	.964
WRSTAND	.538	.070	.294	.231	.329	.536	.724	.600	.714	.654	.768
HOSTAND	.473	.141	.180	.244	.297	.528	.611	.595	.658	.530	.638
TESTSCOR	.562	.118	.262	.264	.348	.593	.742	.665	.763	.658	.781

TABLE C-6 (Cont'd)

	DREL	DRSC	DRST	DROF	DRGCT	WRSTAND	HOSTAND	TESTSCOR
ARGI	.729	.722	.690	.689	.712	.650	.498	.638
ARNO	.612	.579	.648	.519	.573	.528	.376	.501
ARAO	.299	.286	.312	.236	.274	.141	.156	.165
ARWK	.789	.838	.784	.719	.854	.681	.576	.699
ARAR	.793	.820	.822	.644	.808	.655	.582	.688
ARSP	.614	.697	.608	.455	.667	.502	.467	.539
ARMK	.777	.748	.807	.621	.735	.645	.555	.667
AREI	.784	.756	.708	.736	.725	.592	.538	.628
ARMC	.727	.803	.688	.677	.761	.596	.603	.668
ARGS	.797	.789	.771	.689	.790	.678	.590	.705
ARSI	.684	.698	.611	.687	.657	.589	.478	.593
ARAI	.654	.682	.587	.755	.637	.538	.473	.562
ARCM	.220	.211	.164	.285	.172	.070	.141	.118
ARCA	.229	.278	.264	.261	.302	.294	.180	.262
ARCE	.253	.275	.271	.180	.262	.231	.244	.264
ARCC	.372	.450	.351	.322	.434	.329	.297	.348
DRCO	.800	.831	.768	.673	.813	.536	.528	.593
DRFA	.975	.895	.934	.824	.887	.724	.611	.742
DRMM	.866	.817	.768	.874	.776	.600	.595	.665
DRGM	.916	.921	.896	.854	.870	.714	.658	.763
DRCL	.863	.866	.868	.707	.880	.654	.530	.658
DRGT	.901	.944	.902	.726	.964	.768	.638	.781
DREL	1.000	.912	.970	.766	.903	.724	.624	.749
DRSC	.912	1.000	.896	.775	.984	.740	.678	.789
DRST	.970	.896	1.000	.704	.892	.731	.605	.743
DROF	.766	.775	.704	1.000	.739	.642	.572	.675
DRGCT	.903	.984	.892	.739	1.000	.739	.661	.779
WRSTAND	.724	.740	.731	.642	.739	1.000	.612	.893
HOSTAND	.624	.678	.605	.572	.661	.612	1.000	.903
TESTSCOR	.749	.789	.743	.675	.779	.893	.903	1.000

TABLE C-7

INTERCORRELATION MATRICES FOR INFANTRY RIFLEMAN
TESTED WITH ASVAB 8/9/10

Part A: Uncorrected Intercorrelation Matrix

	Mean	Standard deviation
AR8GS	16.679	3.877
AR8AR	21.000	5.339
AR8WK	27.925	4.953
AR8PC	11.755	2.385
AR8NO	37.887	7.963
AR8CS	46.038	11.502
AR8AS	17.679	4.607
AR8MK	13.679	5.026
AR8MC	17.793	4.276
AR8EI	13.472	3.214
D8CL	102.830	18.530
D8CO	101.226	17.422
D8EL	103.566	15.664
D8FA	103.641	17.474
D8GM	103.264	18.282
D8GT	103.283	16.472
D8MM	103.491	19.048
WRSTAND	53.287	9.691
HOSTAND	52.129	10.121
TESTSCOR	105.416	16.858
FCGST	52.355	9.365
WRFCG	105.641	16.723
PROFIC	157.770	23.116

N OF CASES = 53

TABLE C-7 (Cont'd)

Variable	Description
AR8GS	General Science subtest raw score, tested at AFEES[a]
AR8AR	Arithmetic Reasoning subtest raw score, tested at AFEES
AR8WK	Word Knowledge subtest raw score, tested at AFEES
AR8PC	Paragraph Comprehension subtest raw score, tested at AFEES
AR8NO	Numerical Operations subtest raw score, tested at AFEES
AR8CS	Coding Speed subtest raw score, tested at AFEES
AR8AS	Auto/Shop Information subtest raw score, tested at AFEES
AR8MK	Mathematics Knowledge subtest raw score, tested at AFEES
AR8MC	Mechanical Comprehension subtest raw score, tested at AFEES
AR8EI	Electronics Information subtest raw score, tested at AFEES
D8CL	Clerical aptitude composite, tested at Depot
D8CO	Combat aptitude composite, tested at Depot
D8EL	Electronics Repair aptitude composite, tested at Depot
D8FA	Field Artillery aptitude composite, tested at Depot
D8GM	General Maintenance aptitude composite, tested at Depot
D8GT	General Technical aptitude composite, tested at Depot
D8MM	Mechanical Maintenance aptitude composite, tested at Depot
WRSTAND	Written test score, standardized
HOSTAND	Hands-on test score, standardized
TESTSCOR	WRSTAND plus HOSTAND
FCGST	Final course grade (training), standardized
WRFCG	WRSTAND plus FCGST
PROFIC	WRSTAND plus HOSTAND plus FCGST

[a]Forms 8, 9, and 10 of the ASVAB.

TABLE C-7 (Cont'd)

	ARBGS	ARBAR	ARBWK	ARBPC	ARBNO	ARBCS	ARBAS	ARBMK	ARBMC	ARBEI	DBCL	DBCO	DBEL
ARBGS	1.000	.577	.768	.607	.228	.168	.612	.620	.568	.608	.383	.613	.723
ARBAR	.577	1.000	.444	.550	.495	.515	.425	.798	.468	.460	.388	.510	.723
ARBWK	.768	.444	1.000	.619	.099	.204	.477	.630	.522	.488	.275	.544	.675
ARBPC	.607	.550	.619	1.000	.127	.178	.490	.605	.397	.512	.350	.576	.693
ARBNO	.228	.495	.099	.127	1.000	.546	.156	.370	-.001	.091	.391	.319	.276
ARBCS	.168	.515	.204	.178	.546	1.000	.204	.406	.263	.201	.528	.425	.398
ARBAS	.612	.425	.477	.490	.156	.204	1.000	.466	.571	.710	.251	.579	.670
ARBMK	.620	.798	.630	.605	.370	.406	.466	1.000	.615	.499	.351	.539	.734
ARBMC	.568	.468	.522	.397	-.001	.263	.571	.615	1.000	.645	.231	.477	.632
ARBEI	.608	.460	.488	.512	.091	.201	.710	.499	.645	1.000	.176	.487	.681
DBCL	.383	.388	.275	.350	.391	.528	.251	.351	.231	.176	1.000	.827	.575
DBCO	.613	.510	.544	.576	.319	.425	.579	.539	.477	.487	.827	1.000	.847
DBEL	.723	.723	.675	.693	.276	.398	.670	.734	.632	.681	.575	.847	1.000
DBFA	.720	.658	.665	.646	.261	.361	.658	.693	.610	.663	.631	.894	.959
DBGM	.656	.539	.623	.648	.161	.327	.713	.600	.614	.660	.578	.897	.944
DBGT	.708	.721	.668	.640	.303	.375	.487	.716	.538	.576	.639	.813	.920
DBMM	.629	.563	.543	.528	.140	.373	.706	.606	.691	.693	.566	.854	.922
WRSTAND	.559	.442	.626	.425	.215	.296	.276	.512	.405	.473	.313	.479	.531
HOSTAND	.415	.260	.385	.478	.140	.134	.421	.449	.501	.445	.205	.402	.415
TESTSCOR	.571	.410	.591	.532	.208	.251	.411	.564	.534	.539	.303	.517	.554
FCGST	.218	.247	.310	.214	-.032	.076	.131	.311	.302	.295	-.036	.131	.183
WRFCG	.446	.394	.536	.366	.107	.214	.233	.471	.404	.439	.161	.351	.410
PROFIC	.504	.399	.557	.474	.139	.213	.353	.537	.512	.512	.206	.430	.479

TABLE C-7 (Cont'd)

	D8FA	D8GM	D8GT	D8MM	WRSTAND	HOSTAND	TESTSCOR	FCGST	WRFCG	PROFIC
AR8GS	.720	.656	.708	.629	.559	.415	.571	.218	.446	.504
AR8AR	.658	.539	.721	.563	.442	.260	.410	.247	.394	.399
AR8WK	.665	.623	.668	.543	.626	.385	.591	.310	.536	.557
AR8PC	.646	.648	.640	.528	.425	.478	.532	.214	.366	.474
AR8NO	.261	.161	.303	.140	.215	.140	.208	-.032	.107	.139
AR8CS	.361	.327	.375	.373	.296	.134	.251	.076	.214	.213
AR8AS	.658	.713	.487	.706	.276	.421	.411	.131	.233	.353
AR8MK	.693	.600	.716	.606	.512	.449	.564	.311	.471	.537
AR8MC	.610	.614	.538	.691	.405	.501	.534	.302	.404	.512
AR8EI	.663	.660	.576	.693	.473	.445	.539	.295	.439	.512
D8CL	.631	.578	.639	.566	.313	.205	.303	-.036	.161	.206
D8CO	.894	.897	.813	.854	.479	.402	.517	.131	.351	.430
D8EL	.959	.944	.920	.922	.531	.415	.554	.183	.410	.479
D8FA	1.000	.943	.944	.936	.537	.429	.566	.222	.435	.503
D8GM	.943	1.000	.823	.951	.477	.424	.529	.146	.358	.445
D8GT	.944	.823	1.000	.823	.553	.367	.538	.210	.438	.478
D8MM	.936	.951	.823	1.000	.427	.428	.502	.164	.339	.433
WRSTAND	.537	.477	.553	.427	1.000	.448	.844	.540	.882	.834
HOSTAND	.429	.424	.367	.428	.448	1.000	.858	.340	.450	.763
TESTSCOR	.566	.529	.538	.502	.844	.858	1.000	.514	.777	.938
FCGST	.222	.146	.210	.164	.540	.340	.514	1.000	.873	.780
WRFCG	.435	.358	.438	.339	.882	.450	.777	.873	1.000	.920
PROFIC	.503	.445	.478	.433	.834	.763	.938	.780	.920	1.000

TABLE C-7 (Cont'd)

Part B: Corrected Intercorrelation Matrix

	Mean	Standard deviation
AR8GS	16.679	5.010
AR8AR	21.000	7.370
AR8WK	27.925	7.710
AR8PC	11.755	3.360
AR8NO	37.887	10.990
AR8CS	46.038	16.250
AR8AS	17.679	5.550
AR8MK	13.679	6.390
AR8MC	17.793	5.350
AR8EI	13.472	4.240
D8CL	102.830	23.547
D8CO	101.226	22.940
D8EL	103.566	21.872
D8FA	103.642	23.655
D8GM	103.264	23.621
D8GT	103.283	23.282
D8MM	103.491	23.330
WRSTAND	53.287	13.476
HOSTAND	52.129	11.624
TESTSCOR	105.416	22.300
FCGST	52.355	10.202
WRFCG	105.642	21.267
PROFIC	157.770	29.341

N OF CASES = 53

TABLE C-7 (Cont'd)

	ARBGS	ARBAR	ARBWK	ARBPC	ARBND	ARBCS	ARBAS	ARBMK	ARBMC	ARBEI	DBCL	DBCO	DBEL
ARBGS	1.000	.720	.800	.690	.520	.450	.640	.690	.700	.760	.519	.738	.823
ARBAR	.720	1.000	.710	.670	.630	.510	.530	.830	.690	.660	.412	.638	.841
ARBWK	.800	.710	1.000	.800	.600	.550	.530	.670	.600	.680	.480	.736	.839
ARBPC	.690	.670	.800	1.000	.600	.560	.420	.640	.520	.570	.578	.747	.786
ARBND	.520	.630	.600	.600	1.000	.700	.300	.620	.400	.410	.584	.635	.614
ARBCS	.450	.510	.550	.560	.700	1.000	.220	.520	.340	.340	.727	.655	.566
ARBAS	.640	.530	.530	.420	.300	.220	1.000	.410	.740	.750	.225	.576	.682
ARBMK	.690	.830	.670	.640	.620	.520	.410	1.000	.600	.590	.448	.607	.754
ARBMC	.700	.690	.600	.520	.400	.340	.740	.600	1.000	.740	.326	.615	.752
ARBEI	.760	.660	.680	.570	.410	.340	.750	.590	.740	1.000	.285	.611	.788
DBCL	.519	.412	.480	.578	.584	.727	.225	.448	.326	.285	1.000	.848	.611
DBCO	.738	.638	.736	.747	.635	.655	.576	.607	.615	.611	.848	1.000	.883
DBEL	.823	.841	.839	.786	.614	.566	.682	.754	.752	.788	.611	.883	1.000
DBFA	.823	.799	.822	.754	.598	.548	.678	.733	.735	.781	.651	.912	.977
DBGM	.775	.708	.783	.747	.536	.533	.727	.637	.735	.758	.634	.924	.961
DBGT	.812	.839	.839	.777	.632	.572	.537	.770	.668	.725	.660	.863	.955
DBMM	.761	.709	.681	.611	.451	.487	.759	.636	.789	.785	.584	.867	.929
WRSTAND	.719	.663	.813	.684	.594	.568	.381	.654	.519	.655	.506	.687	.741
HOSTAND	.550	.439	.524	.614	.502	.395	.446	.531	.572	.518	.415	.576	.559
TESTSCOR	.721	.629	.764	.733	.621	.549	.463	.672	.612	.666	.522	.715	.739
FCGST	.373	.456	.460	.353	.234	.194	.256	.429	.383	.446	.077	.286	.384
WRFCG	.635	.639	.736	.603	.489	.453	.364	.620	.513	.629	.358	.573	.654
PROFIC	.678	.637	.741	.680	.553	.485	.441	.660	.598	.661	.424	.643	.695

TABLE C-7 (Cont'd)

	D8FA	D8GM	D8GT	D8MM	WRSTAND	HOSTAND	TESTSCOR	FCGST	WRFCG	PROFIC
AR8GS	.823	.775	.812	.761	.719	.550	.721	.373	.635	.678
AR8AR	.799	.708	.839	.709	.663	.439	.629	.456	.639	.637
AR8WK	.822	.793	.839	.681	.813	.524	.764	.460	.736	.741
AR8PC	.754	.747	.777	.611	.684	.614	.733	.353	.603	.680
AR8NO	.598	.536	.632	.451	.594	.502	.621	.234	.489	.553
AR8CS	.548	.533	.572	.487	.568	.395	.549	.194	.453	.485
AR8AS	.678	.727	.537	.759	.381	.446	.463	.256	.364	.441
AR8MK	.733	.637	.770	.636	.654	.531	.672	.429	.620	.660
AR8MC	.735	.735	.668	.789	.519	.572	.612	.383	.513	.598
AR8EI	.781	.758	.725	.785	.655	.518	.666	.446	.629	.661
D8CL	.651	.634	.660	.584	.506	.415	.522	.077	.358	.424
D8CO	.912	.924	.863	.867	.687	.576	.715	.286	.573	.643
D8EL	.977	.961	.955	.929	.741	.559	.739	.384	.654	.695
D8FA	1.000	.962	.966	.943	.738	.567	.742	.402	.661	.704
D8GM	.962	1.000	.885	.956	.682	.559	.704	.322	.587	.647
D8GT	.966	.885	1.000	.857	.765	.532	.740	.406	.680	.704
D8MM	.943	.956	.857	1.000	.604	.533	.643	.318	.535	.599
WRSTAND	.738	.682	.765	.604	1.000	.576	.905	.606	.924	.898
HOSTAND	.567	.559	.532	.533	.576	1.000	.870	.392	.553	.797
TESTSCOR	.742	.704	.740	.643	.905	.870	1.000	.570	.847	.958
FCGST	.402	.322	.406	.318	.606	.392	.570	1.000	.864	.781
WRFCG	.661	.587	.680	.535	.924	.553	.847	.864	1.000	.944
PROFIC	.704	.647	.704	.599	.898	.797	.958	.781	.944	1.000

TABLE C-8

INTERCORRELATION MATRICES FOR COMBINED INFANTRY RIFLEMAN SAMPLES, TESTED WITH ASVAB 6, 7, 8, 9, AND 10

Part A: Uncorrected Intercorrelation Matrix

	Mean	Standard deviation
GS	48.494	7.846
AR	49.357	7.546
WK	49.403	6.498
NO	49.363	8.366
AS	49.975	7.918
MK	48.764	8.207
MC	49.714	8.507
EI	49.535	8.044
WRSTAND	50.990	9.160
HOSTAND	50.383	10.160
TESTSCST	49.984	10.000
CORECODE	95.585	13.557
AMGS	51.448	16.057
TIMEIN	12.979	9.181
RANK	2.104	.781

N OF CASES = 241

TABLE C-8 (Cont'd)

Variable	Description
GS	General Science subtest standard score, ASVAB forms 6, 7, 8, 9, and 10
AR	Arithmetic Reasoning subtest standard score, ASVAB forms 6, 7, 8, 9, and 10
WK	Word Knowledge subtest standard score, ASVAB forms 6, 7, 8, 9, and 10
NO	Numerical Operations subtest standard score, ASVAB forms 6, 7, 8, 9, and 10
AS	Auto/Shop Information subtest standard score, ASVAB forms 6, 7, 8, 9, and 10
MK	Mathematics Knowledge subtest standard score, ASVAB forms 6, 7, 8, 9, and 10
MC	Mechanical Comprehension subtest standard score, ASVAB forms 6, 7, 8, 9, and 10
EI	Electronics Information subtest standard score, ASVAB forms 6, 7, 8, 9, and 10
WRSTAND	Written test, standardized
HOSTAND	Hands-on test, standardized
TESTSCST	WRSTAND plus HOSTAND, standardized
CORECODE	Combat aptitude composite standard score
AMGS	AFQT score, tested at AFEES
TIMEIN	Time served in the Marine Corps, computed
RANK	Enlisted grade

TABLE C-8 (Cont'd)

	GS	AR	WK	NO	AS	MK	MC	EI	WRSTAND	HOSTAND	TESTSCST
GS	1.000	.467	.632	.234	.583	.479	.583	.565	.492	.365	.498
AR	.467	1.000	.477	.334	.413	.587	.457	.433	.375	.251	.363
WK	.632	.477	1.000	.132	.469	.436	.480	.507	.481	.325	.467
NO	.234	.334	.132	1.000	.158	.416	.058	.120	.231	.086	.181
AS	.583	.413	.469	.158	1.000	.289	.600	.663	.413	.361	.451
MK	.479	.587	.436	.416	.289	1.000	.440	.379	.438	.323	.442
MC	.583	.457	.480	.058	.600	.440	1.000	.584	.372	.406	.457
EI	.565	.433	.507	.120	.663	.379	.584	1.000	.410	.334	.433
WRSTAND	.492	.375	.481	.231	.413	.438	.372	.410	1.000	.457	.837
HOSTAND	.365	.251	.325	.086	.361	.323	.406	.334	.457	1.000	.870
TESTSCST	.498	.363	.467	.181	.451	.442	.457	.433	.837	.870	1.000
CORECODE	.667	.598	.707	.645	.757	.544	.531	.592	.518	.365	.512
AMGS	.604	.707	.702	.368	.458	.631	.508	.502	.512	.379	.518
TIMEIN	-.183	-.230	-.129	-.079	-.195	-.137	-.155	-.162	-.161	-.094	-.147
RANK	-.185	-.320	-.263	-.051	-.212	-.148	-.228	-.181	.002	-.002	.000

TABLE C-8 (Cont'd)

	CORECODE	AMGS	TIMEIN	RANK
GS	.667	.604	-.183	-.185
AR	.588	.707	-.230	-.320
WK	.707	.702	-.129	-.263
NO	.645	.368	-.079	-.051
AS	.757	.458	-.195	-.212
MK	.544	.631	-.137	-.148
MC	.531	.508	-.155	-.228
EI	.592	.502	-.162	-.181
WRSTAND	.518	.512	-.161	.002
HOSTAND	.365	.379	-.094	-.002
TESTSCST	.512	.518	-.147	.000
CORECODE	1.000	.720	-.202	-.234
AMGS	.720	1.000	-.077	-.094
TIMEIN	-.202	-.077	1.000	.381
RANK	-.234	-.094	.381	1.000

TABLE C-8 (Cont'd)

Part B: Corrected Intercorrelation Matrix

	Mean	Standard deviation
GS	43.494	10.000
AR	49.357	10.000
WK	49.403	10.000
NO	49.863	10.000
AS	49.975	10.000
MK	43.764	10.000
MC	49.714	10.000
EI	48.535	10.000
WRSTAND	50.990	10.926
HOSTAND	50.383	10.941
TESTSCST	49.984	11.638
CORECODE	95.585	20.474
AMGS	51.448	23.192
TIMEIN	12.979	9.400
RANK	2.104	.826

N OF CASES = 241

TABLE C-8 (Cont'd)

	GS	AR	WK	NO	AS	MK	MC	EI	WRSTAND	HOSTAND	TESTSCST
GS	1.000	.720	.800	.520	.640	.690	.700	.760	.670	.497	.661
AR	.720	1.000	.710	.630	.530	.830	.690	.660	.612	.446	.600
WK	.800	.710	1.000	.600	.530	.670	.600	.680	.673	.455	.639
NO	.520	.630	.600	1.000	.300	.620	.400	.410	.488	.290	.441
AS	.640	.530	.530	.300	1.000	.410	.740	.750	.519	.472	.562
MK	.690	.830	.670	.620	.410	1.000	.600	.590	.612	.446	.600
MC	.700	.690	.600	.400	.740	.600	1.000	.740	.548	.518	.604
EI	.760	.660	.680	.410	.750	.590	.740	1.000	.602	.484	.616
WRSTAND	.670	.612	.673	.488	.519	.612	.548	.602	1.000	.556	.882
HOSTAND	.497	.446	.455	.290	.472	.446	.518	.484	.556	1.000	.882
TESTSCST	.661	.600	.639	.441	.562	.600	.604	.616	.882	.882	1.000
CORECODE	.811	.782	.880	.784	.750	.710	.724	.759	.694	.510	.682
AMGS	.783	.848	.857	.673	.539	.797	.666	.691	.691	.506	.679
TIMEIN	-.275	-.305	-.225	-.178	-.266	-.246	-.264	-.264	-.249	-.174	-.240
RANK	-.359	-.440	-.403	-.275	-.321	-.340	-.375	-.341	-.190	-.137	-.185

TABLE C-8 (Cont'd)

	CORECODE	AMGS	TIMEIN	RANK
GS	.811	.789	-.275	-.359
AR	.782	.848	-.305	-.440
WK	.880	.857	-.225	-.403
NO	.784	.673	-.178	-.275
AS	.750	.539	-.266	-.321
MK	.710	.797	-.246	-.340
MC	.724	.666	-.264	-.375
EI	.759	.691	-.264	-.341
WRSTAND	.694	.691	-.249	-.190
HOSTAND	.510	.506	-.174	-.137
TESTSCST	.682	.679	-.240	-.185
CORECODE	1.000	.864	-.284	-.410
AMGS	.864	1.000	-.197	-.302
TIMEIN	-.284	-.197	1.000	.422
RANK	-.410	-.302	.422	1.000

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REPORT DOCUMENTATION PAGE

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18. SUPPLEMENTARY NOTES

The work reported here was conducted under the direction of the Center for Naval Analyses and represents the opinion of the Cnter for Naval Analyses at the time of issue. It does not necessarily represent the opinion of the Commandant, Marine Corps.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Aptitude tests, ASVAB (Armed Services Vocational Aptitude Battery), Enlisted personnel, Job training, Performance (human), Performance tests, Qualifications, Statistical analysis

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The purpose of this study was to evaluate the feasibility of validating ASVAB enlistment standards against job performance. Hands-on and written proficiency tests were developed for three Marine Corps skills--Ground Radio Repair, Automotive Mechanic, and Infantry Rifleman--for use as measures of job performance. In addition, grades in skill training courses were also evaluated as possible measures of job performance.

The ASVAB was shown to be a valid predictor of job performance. All three measures--hands-on tests, written tests, and training grades--were generally

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20 consistent measures of performance. A preliminary set of ASVAB qualification standards for assigning recruits to these three skills was computed using the hands-on and written tests as the criterion measure. The ASVAB standards derived from this analysis are similar to the standards based on the traditional criterion measure of training-course grades. We conclude that validating ASVAB enlistment standards against job performance appears to be feasible. Although job performance tests can be used for this purpose, they are costly to develop and administer. Training grades, which are routinely available, may serve as a satisfactory and economical proxy for them in many skills.